BYPRODUCT POWER—PROCESS STEAM—N.A.P.E.

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POWER

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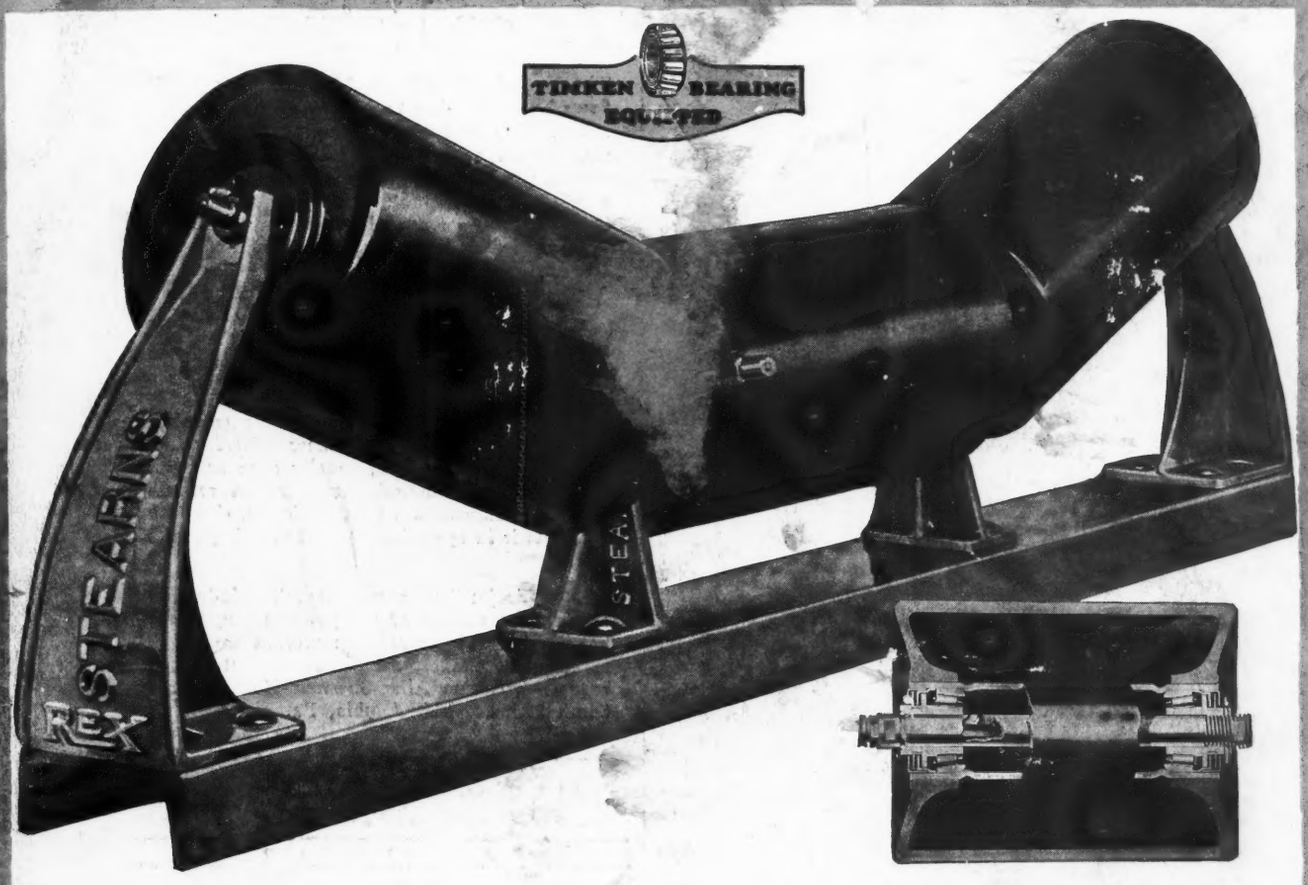

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Contents for August 27, 1929

VOLUME 70, NUMBER 9

Copyright, 1929, by McGraw-Hill Publishing Company, Inc.

Combinations of Power and Process That Reduce Costs.....316
HIGHER STEAM PRESSURES enable power to be generated cheaply from steam that is to be used in processing. BY R. B. PURDY AND L. H. MORRISON

Power and Industrial Steam Plant Built for Hanes Knitting Company..321
WITH POWER and steam demands 25 per cent greater, the total coal consumption has been increased but 11 per cent. BY P. L. HOLLAND

Process Requirements Dictate Power Plant Design.....324
THE INDUSTRIAL RAYON CORPORATION finds that 250 lb. at the turbine throttle gives the most economical heat balance.

Power Services in the Rayon Plant.....328
AIR CONDITIONING and refrigeration employed to insure high-quality of the finished product.

New Heald Paper Mill Combines Power and Process.....332
HIGH-PRESSURE boilers, pulverized-coal burners and bleeder and back-pressure turbines included in the power house equipment.

Evaporators, in New Application, Generate Process Steam.....335
PURE FEED WATER and an oil-free steam obtainable through a new use of a time-proved device.

Power Development in the Tennessee Basin.....338
THIS TERRITORY faces an industrial expansion that will fast convert it into an important manufacturing center. BY J. A. SWITZER

Points of Interest at the N.A.P.E. Convention.....342

Editorials 314
Right Out of the Plant..344
New Plant Construction.357
What's New in Plant Equipment.....347
From Among the Readers Problems.....350
Events and Men in Power's Field.....352

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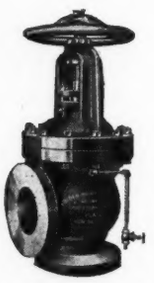

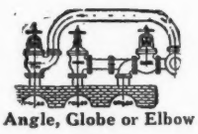

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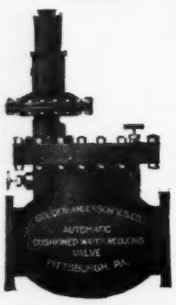

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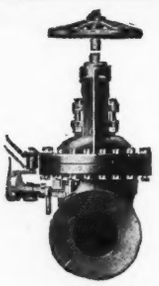

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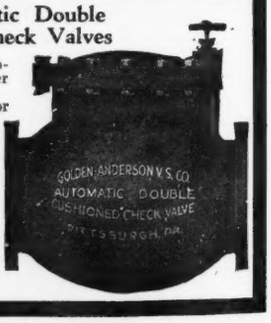

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POWER

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The N.A.P.E. and Education

IN THE last foreword I tried to direct attention to the development of the power-plant engineer that has of necessity accompanied the wonderful increase in capacity and complexity of power-producing and distributing installations during the past half century.

He has had to learn not only how to operate and maintain boilers, engines, turbines and internal combustion machinery under pressures, speeds, temperatures and rates of output undreamed of fifty years ago, but, unless contented to remain a mere operator under direction, he has had to learn the principles as well as the practice, the proper functions, adaptation and limitations of new types of apparatus, the keeping of accounts and the niceties of management.

A potent factor in meeting the demands of industry for this type of man has been the National Association of Stationary Engineers, recently become the National Association of Power Engineers.

It grew out of the desire of men engaged in an increasingly complex and important vocation to discuss their problems and exchange helpful information.

The fact that it is modeled after the secret fraternal society, while it has conduced to confidence and freedom in discussion and provided the advantage of a fixed order of procedure, has somewhat militated against its recognition as an organization for the dissemination of technical information and for mutual instruction.

Although education is put forward in its declaration of principles as one of its major purposes, the initiation and carrying out of educational programs were left to the individual local associations without, until recently, any direction or assistance from the national body.

Three years ago at a national convention a system was instituted whereby members having passed examinations in various branches of power-plant engineering were awarded Certificates of Merit.

Holders of these certificates are in high favor among employers of power-plant men, and the study of the courses evolves much material for discussion at the local meetings.

There have also been established at headquarters an Information Service Department and a Power-Plant Costs Service, from which any member may obtain information upon any subject connected with power-plant design or operation, or be helped through the intricacies of power-plant accounts.

After about two years of operation these systems are beginning to demonstrate their value, but, unfortunately, they have not the sympathetic support of the entire membership.

It will prejudicially affect the public estimate of the sincerity of the protestations of the N.A.P.E. that it is first of all an educational organization and it will hamper the growth which goes with the successful accomplishment of a purpose if at the coming convention there is any manifestation of failing interest in, sympathy with and support of the educational activities of the association.

F. R. Low

ECONOMY OF BYPRODUCT POWER

[AN EDITORIAL]

THE National Association of Power Engineers holds its National Meeting in Chattanooga, Tenn., from Sept. 9 to 15. This organization of power plant engineers has always been keen in examining methods of producing power cheaply, and no better occasion can exist than now to call attention to the manifold advantages accruing through the combination of power plant and processing mill, whereby the needed power can be developed from the steam that is used in such processing as heating, air conditioning, dye vat work and bleaching.

NO mathematical legerdemain or thermodynamical treatise is needed to prove the economy of producing power from process steam. However, in spite of the manifest advantages, the fact remains that in thousands of plants live steam from boilers is led directly into the process mains.

So much has been written of the large condensing steam stations that many have acquired the idea that unless a power plant be of large capacity it cannot be efficient. This is true if comparison is being made with small condensing steam plants. But when the steam passing through the engine or boiler is subsequently used in the mill, the heat in the steam, and in the coal, for that matter, that is chargeable to power generation is less than one-half that needed in the largest and most efficient condensing plant. For while a pound of coal per kilowatt-hour is still unattainable in condensing plants, save in a few base-load central stations, less than half a pound will supply the heat needed to develop a like amount of power in a combined power and process plant.

AS is outlined in the first article of this issue of *Power,* there are numerous methods whereby steam can be put to work before it enters the process lines. Where power can be purchased cheaply, an economical arrangement embodies the installation of a back pressure engine or turbine to develop as much power as possible, with the remainder purchased. Or a condensing and a non-condensing unit may carry all the power load, generating as much as possible from the process steam.

By increasing the boiler pressure the power obtainable through a pressure drop to any stated process pressure is increased, but even two or three hundred pounds pressure permits a considerable amount of power to be developed, although the back pressure is as high as fifty pounds. Just what boiler pressure should be carried depends upon many factors, including boiler costs, amounts of power and process heat required, and the cost of fuel. In fact, in many existing plants having medium pressure boilers, power could be advantageously produced from the process steam. Even if energy is purchased, arrangements can be made with certain of the public utilities to float a process-steam turbine on the line, generating as much as possible of the power needed in the mill.

OBTAINING advantages of the combined power and process hook up need not require a complete new power plant. If the existing boiler pressure permits an expansion ratio of six or more in a generating unit, there probably will be economy in installing such unit, either of the straight back-pressure or of the bleeding type.

IN various plants generating units now operate condensing, and live steam is supplied to the processes. If the unit is a turbine, adapting it to back-pressure conditions will involve expensive alterations, and a new and correctly proportioned turbine will pay for itself through its better efficiency. A condensing reciprocating engine can easily be changed to non-condensing operation. While the steam rate in both instances will be increased, the total amount of steam produced by the boilers will be reduced materially, the amount depending upon the balance between process and power requirements.

IN SOME industries the cost of power and steam is a large percentage of the total manufacturing cost. In a paper mill the cost runs as high as 60 per cent of the total. The advantage of the twofold use of steam is obvious.

A typical arrangement wherein the manufacturing department and the power plant of a paper mill are tied together is described on Page 332. It shows the modern tendencies in this direction. Even the power usually needed to handle the condenser cooling water is practically eliminated as a power plant cost, for in this plant the cooling water goes to the paper machines.

The economy obtained by discarding the old boilers and constructing a new boiler and generating plant is fully outlined in an article on a North Carolina knitting mill appearing in this issue. The saving resulting from the abandonment of outside current and the generation of all power from steam needed in processes, fully justified the engineers' estimates.

❖

THE inter-relation of process demands and power requirements is such that the former are equally influential in dictating the power plant equipment. In the rayon mills, as shown in one of the articles of this issue, the process requirements really dictate the boiler pressure and turbine specifications. Through proper co-ordination the loss to the condensing water is reduced to an economical minimum.

❖

FREQUENTLY the processing is so delicate that even the slightest trace of lubricating oil in the steam is prohibitive. For this reason many plants now using reciprocating engines are content to operate them condensing and draw the mill steam directly from the boilers. With the latest development in high-pressure evaporators the engine's exhaust steam can be used to generate a clean low-pressure steam for the process.

This type of evaporator has been installed in plants where the exhaust is as high as four hundred pounds, and as there must be a temperature difference in the evaporator the process pressure drop is as much as one hundred pounds. But when lower process pressures can be used, the temperature difference per pound of pressure difference in the evaporator increases, so the actual difference between the exhaust and the process pressures need be but a few pounds to give the same temperature difference as exists when the evaporator pressures are four hundred and three hundred pounds. The industrial field offers a wide range of application for evaporators.

Evaporators are destined to play an important part in the modernization of industrial power plants. While customarily used to provide make-up boiler feed in central stations, industrial plants have been slow to adopt the idea, for the necessity was less pressing. Even though the withdrawals of steam for process call for a large boiler feed makeup, raw water or heated water is deemed sufficient under low-pressure conditions. But high pressures and high rates of steaming require a pure boiler feed, and in many instances this can best be obtained by evaporators. By interposing the evaporators between the turbine or engine and the process main, the exhaust steam is condensed by evaporating process steam from raw water, and the condensate is returned to the feedwater system. The boiler is then supplied continuously with the original charge of feed water, plus a small makeup for gland and pipe leakage.

❖

THE striking feature of the several power plants covered in this issue of *Power* is that all of these plants are making use of moderate pressures. This fully substantiates the claim that pressures suitable for a plant engaged solely in producing power may not be economical if processes and power are interlinked.

Now that designing engineers and equipment manufacturers are giving attention to the factory power plant and are building equipment to meet its special conditions, there is a noticeable improvement in the economy of new and old industrial power plants. By proper engineering, a factory can do much to reduce its costs, through a power-and-process hookup.

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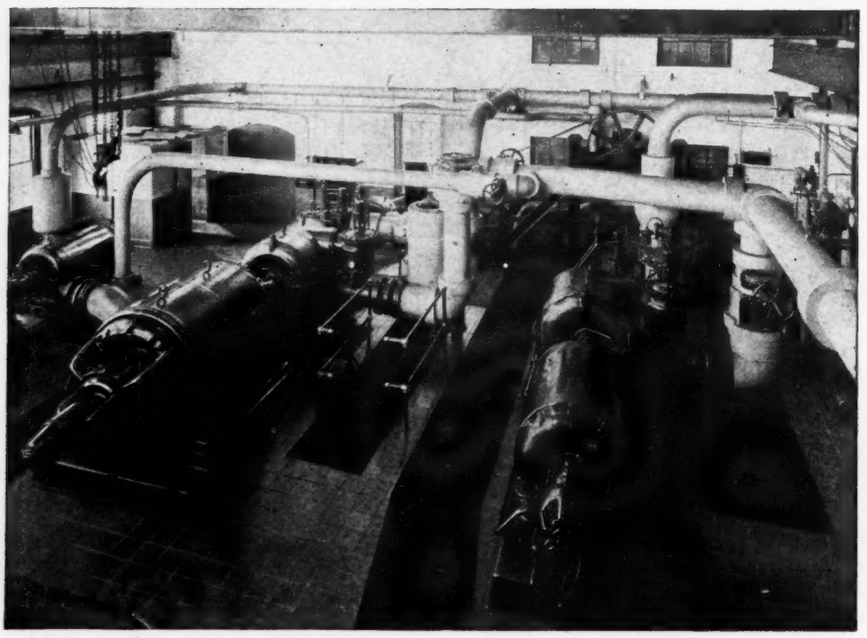


A plant using turbine steam in process work

COMBINATIONS OF *Power and Process* THAT REDUCE COSTS

By R. B. Purdy and L. H. Morrison
Power Editorial Staff

COMMERCIAL application of high steam pressures has brought the industrial power plant into the limelight. Engineers are convinced that these higher pressures enable power to be generated cheaply from steam that is to be used in processes, even though the processes require pressures much above atmospheric.

An ideal plant, of course, would be one in which all of the power is generated from process steam, with no steam going to the condenser or exhausting to the atmosphere. This can seldom be obtained, because peak power loads and peak process loads do not always occur at the same time. But by proper correlation of steam pressures, generating units and process requirements, the variations can be reduced to a minimum.

Ratio of Process to Total Power

Even in light metal manufacturing the ratio of power from process steam to total power is higher than might be expected, ranging from 25 to 45 per cent, if building heating be included as a process. The ratio is subject to seasonal changes, for in winter the power may all be from heating steam and in summer the process demand may be low. In those paper mills that still use boiler pressures of 200 lb. or less, the ratio is about 35 per cent; but with high pressures and proper co-ordination of the manufacturing processes all the power can be developed from the process steam. This has been obtained in the finished-cotton industry and in worsted mills, where proper engineering studies have been made and acted upon.

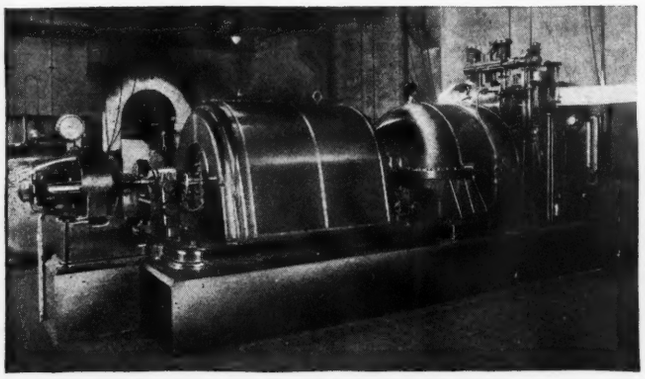
As a starting point in a study of industrial power and process steam one may state that every industrial plant with a substantial process steam load can generate two kinds of power: First, *very cheap power* up to the by-product limitation of the process load; second, *more expensive power,* made from steam going to the condenser or to the atmosphere.

Generation of the first kind of power is always definitely advantageous. An exception to this rule may be a plant where the power load is considerable, with utility electrical rates extremely low, and the process-steam requirements so small as to justify but simple boiler room equipment and low-salaried personnel.

The second kind of power generally costs more to

produce than the generating cost of central-station power and will frequently cost more than the selling price of the latter. This is due to the poorer economy of the smaller units and their greater first cost per unit of capacity.

If an installation is to be economically successful the engineer must select the generating equipment and determine a heat balance layout so that as much as possible



A box factory uses this bleeder turbine

of the power generated will be of the cheap byproduct type. Assuming that the amount of power and the quantity and pressure of the process steam required have been determined from surveys or from estimates, the boiler pressure or initial pressure at the turbine throttle should be decided upon. This pressure may be selected so that the average process-steam demand will generate the average power load as its pressure is reduced in the prime mover from initial pressure to that required in a process-steam main.

With the boiler pressures selected in this way there will be times when a high power load and a low process-steam load exist, under which conditions the deficiency in power must be made up by power either purchased or supplied from steam going to a condenser or to the atmosphere. It may also be that at times there is a low power load and a high demand for process steam. Under these conditions the process steam will have to be supplied from separate low-pressure boilers or through a reducing valve, the latter being the more common practice. The desirable result always should be a maximum amount of byproduct power with a minimum amount of steam going to the condenser and a minimum amount of live steam going through reducing valves to the process, unless the condenser cooling water can be used to meet process hot-water demands.

Obviously, in any particular plant there may be certain conditions of power load and process demand that prevent the application of this broad general rule. For example, when the process condensate is returned to the boiler and when condensing water is not available, it may be advisable to choose a boiler of such pressure that the minimum process steam will generate the maximum power demand, with the remainder of the process steam coming direct from the boiler.

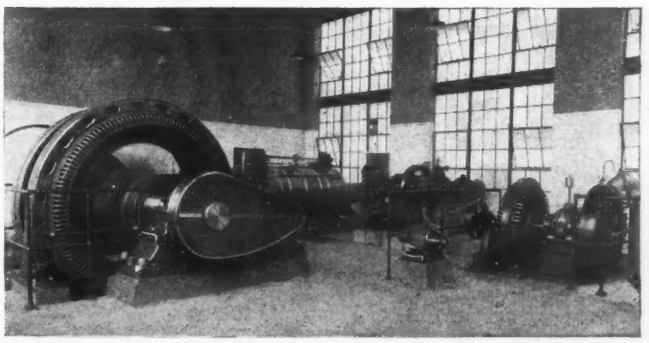
A common method of power plant analyses includes the construction of typical 24-hour-power-load and process-steam-demand curves. By using the steam-rate curve of the prospective prime mover, the hourly power-generation steam can be set up, as shown on the next page. The difference between that curve and the process-steam curve gives the excess and deficiency in the process requirements. By constructing such curves to cover several boiler pressures, which results in differences in steam consumption of the generating unit, the best boiler pressure for the particular conditions can be ascertained with some degree of certainty.

Increased Power From High Pressures

A considerable range in turbine or engine output can be obtained by changes in initial steam pressure. For example, 100 lb. of saturated steam per hour at a pressure of 200 lb. will generate about 2 kw. when expanding through a turbine to 70 lb. back pressure. At 480 lb. pressure the turbine would generate about 4 kw. from 100 lb. of steam, representing a 100 per cent increase in turbine output. If the initial pressure is increased to about 1,000 lb. the increase in output jumps to about 200 per cent. The present availability of high-pressure equipment should make it possible for many industrial plants to secure a better heat balance than has been possible with low pressures.

The next thing to be done is to select the type of prime mover that is to be used. This selection largely depends upon the peculiarities of the industrial process that is to be served. There is a wide variety of prime movers from which to select. For example, one may use a back-pressure turbine or engine, or a combination of a condensing turbine and back-pressure engine. Then there are also various combinations of bleeder turbines, mixed-pressure turbines, and inverted-type turbines, any of which may be used in combination with a steam engine exhausting against a back pressure. In cases where the process-steam load varies considerably, with a constant power load, there may be an advantage in the application of an accumulator to make up the difference between the supply of exhaust or bled steam and the process-steam demand.

In other plants a non-condensing steam engine and a Diesel engine will work out best, especially in the paper



Back pressure uniflow in a paper mill

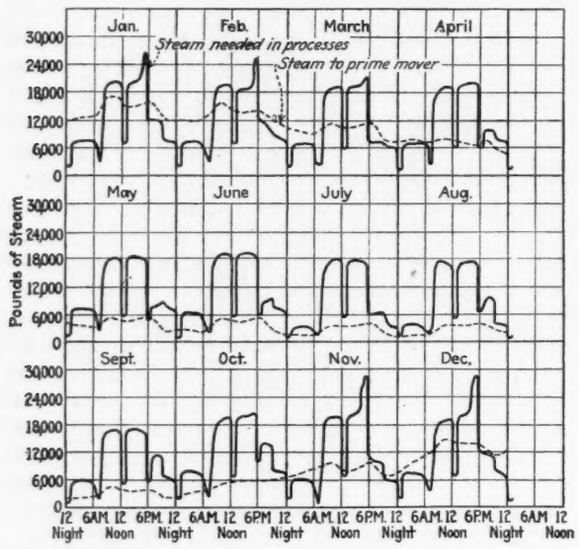
industry, where the power is always beyond that generated from the process steam.

Let us investigate the factors that influence the selection of prime movers from this array of possible conditions.

The back-pressure turbine or engine is the simplest method of obtaining byproduct power from exhaust steam. Its use, however, should be limited to those conditions where the demand for process steam is always nearly equal to or more than enough to produce all of the power required, as under other conditions steam will be lost to the atmosphere. To satisfy the demand for process steam it may at times be necessary to use live

steam either through reducing valves or from low-pressure boilers.

With this arrangement no advantage is gained by installing a highly economical prime mover. Whether engine or turbine is selected depends upon which proves cheapest in first cost and maintenance, and satisfies space requirements. If the process is of a seasonal character, necessitating at other times a considerable loss of exhaust steam to the atmosphere, a uniflow or a compound four-



Combination of power and process average demands

valve engine will usually work out more satisfactorily than a turbine, by reason of their better steam rates, even though the initial cost be higher than in case of the turbine.

If it has not been possible to select an operating pressure that secures a balance between power and process steam, or if the steam required for power generation seems considerably in excess of what can be used in the industrial process, economical operation usually demands that a condensing unit be installed.

Addition of a Condensing Unit

This opens up a large number of possible prime-mover combinations. We may put in two engines, one condensing and one exhausting to process, or condensing and back-pressure turbines, or a condensing turbine and an engine exhausting to process; or a condensing bleeder turbine may take the place of any of these combinations.

If both condensing and back-pressure units are installed, the non-condensing unit must have sufficient capacity to pass all of the steam required by the process. The balance of the load not generated by this unit must then be supplied by the more expensive kilowatts from the condensing unit. In this case it is important that an efficient prime mover be obtained for the non-condensing as well as for the condensing unit. The non-condensing unit should produce as many "cheap kilowatts" from the process-steam load as possible, thus leaving a smaller number of "expensive kilowatts" to be generated by the condensing unit.

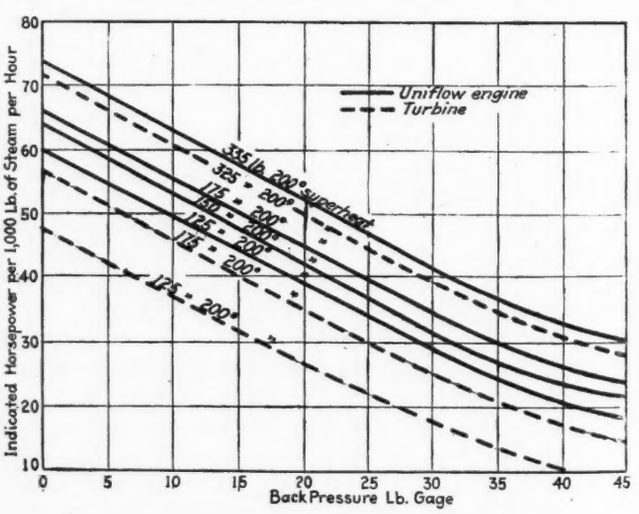
It is not so generally realized, however, that the steam consumption of the engine is better than that of the turbine when exhausting against pressures greater than atmospheric. Even under condensing conditions, for the same initial pressure the engine has a better efficiency. But the turbine with a 28-in. vacuum is more economical than an engine with a 26-in. vacuum, and the cost of increasing the engine's vacuum is not justified by the small increase in efficiency that could be obtained. A comparison of the steam rates of a turbine and an engine exhausting at various pressures is shown in the illustration below.

Frequently the unbalance between process and power demands makes straight back-pressure units uneconomical. It is then profitable to consider the application of a steam accumulator to take up the variation in steam flow and process demand, or to install a bleeder turbine, a condensing and a non-condensing turbine, a condensing and a non-condensing steam engine or a condensing turbine and a non-condensing turbine. The accumulator will be referred to later.

Why Bleeder Turbines Are Popular

The bleeder turbine has had the widest application of all the methods enumerated. This has been due primarily to the comparatively low initial cost of the machine. Such turbines have been standardized by several builders, so that a machine can be adapted to any bleeder pressure by placing the section carrying the bleeder openings or grids at the proper point along the turbine casing. The efficiency of the machine is lowered but slightly by the interposition of the bleeding section. There must, however, always be some steam going to the condenser in order to cool the low-pressure turbine blades, even though the bleeder line is taking not only its maximum withdrawal but is also drawing live steam through a reducing valve. In making a study of the load and steam flow, the engineer can obtain from the turbine builder charts giving the total steam flow and power output for various amounts of steam extraction for any set of pressure conditions. One of the drawings shows the total steam fed to the turbine with various loads and amounts of bleeding. The lowest curve on the sheet represents the performance of the turbine when running without bleeding.

The curves for a corresponding arrangement of two engines, one exhausting into the process main at 15 lb.



Representative horsepower outputs at various back pressures per 1,000 lb. of steam per hour

gage and the second operating condensing at 26 in. vacuum, with the same initial steam condition of 175 lb. and 100 deg. superheat, are also shown.

The ordinates at the bottom of the charts represent total kilowatt load and the vertical ordinates represent

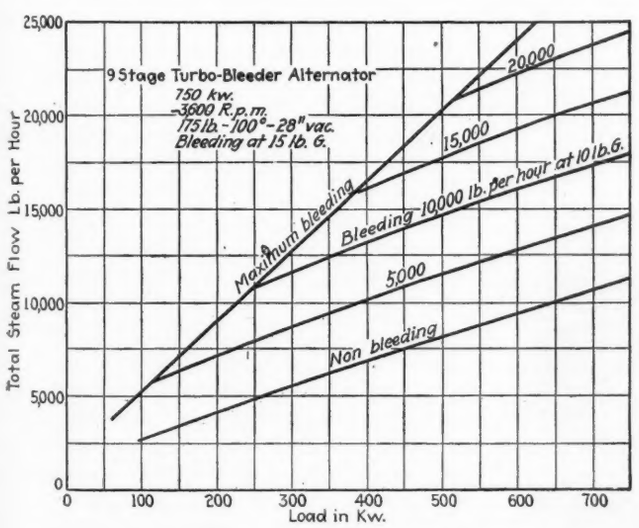
1,000 lb. of steam passing through the throttle per hour. The oblique lines represent pounds of steam passing out of the bleeder valve. The balance, of course, passes through to the condenser.

The oblique lines on the engine chart in a similar manner represent the amount of exhaust issuing from the non-condensing engine, which is the equivalent of the bleeder steam. In other words, these curves consist of the base curve, which is the total steam curve of the non-condensing engine, with the total steam curve of the condensing engine superimposed, its zero point coinciding with various points on the non-condensing curve when bleeding quantities of steam from 4,000 to 20,000 lb. per hour.

As an example, if we assume an average load of 600 kw. and an average process steam load of 16,000 lb. of steam per hour, take the 600-kw. vertical ordinates at the bottom of the curve and follow this vertically upward to the 16,000-lb. line. This will indicate a total throttle flow in the case of the turbine of 19,900 lb. of steam per hour, and in the case of the engine 18,900 lb. of steam per hour. Analyzing the engine slightly further, if you follow the 16,000-lb. line to the left and then drop down to the main curve, you will note that 475 kw. is carried by the non-condensing engine exhausting 16,000 lb. of steam, and the balance, 125 kw., is carried by the condensing engine consuming 2,900 lb. of steam per hour. Had the 125 kw. been generated by a condensing turbine, 3,000 lb. of steam would have been required.

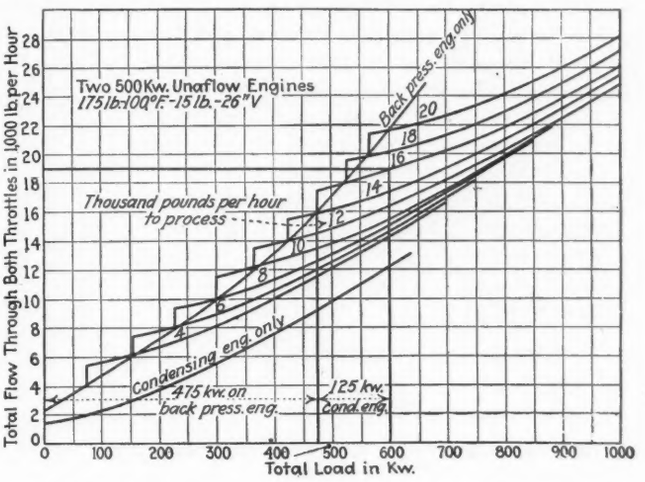
Two Steam Engines Most Efficient Arrangement

Combining these two charts, the steam used by a back-pressure engine and a condensing engine can be computed for the various loads. This has been done and the comparative steam consumption has been tabulated for the two-engine arrangement *E*, the bleeder turbine *T* and the combination of engine and turbine *TE*, for 175 lb. and 100 deg. superheat initial steam and 15 lb. bleeder pressure. Broadly speaking, it seems that the two-engine plant works out, under the special conditions, as the most efficient. Only when the steam is bled in small amounts does the engine-turbine arrangement show its superiority. The reason is that as long as most of the load is covered by the non-condensing engine, the steam rate is lower than with the bleeder turbine.



Total steam flow to a bleeder turbine when various amounts of steam are extracted

Other pressure ranges would not show the same relative proportional steam flow. But as the efficiency of the steam engine increases with higher initial pressure, the turbine would show the better over-all steam rate in the lower ranges. The reason that the turbine almost always is chosen where boiler pressures mount above, say, 300 lbs. is due to constructural reasons involved in building high-pressure reciprocating engines.


Two 500 Kw. Unaflow Engines
175 lb-100°F-15 lb.-26" V
Back press. eng. only
Thousand pounds per hour to process
Condensing eng. only
475 kw. on back press. eng.
125 kw. cond. eng.
Total Flow Through Both Throttles in 1,000 lb. per Hour
Total Load in Kw.

Combined steam rate of two uniflow engines when various amounts of exhaust steam are needed for process

There are many installations where even though the steam turbine shows a higher steam rate, it is preferred over the reciprocating engine. Among them are dye works, especially those engaging in the dyeing of natural and rayon silk. The least appearance of oil in the steam will ruin the entire stock of goods in the vats.

This has led to a tradition that exhaust steam from piston engines cannot be used directly in dye vats.

While this is true under usual conditions, by installing a properly designed oil separator, it is possible to remove all but the faintest trace. Proper choice of lubricating oil, using an oil that has a high boiling point, will assist in overcoming the difficulty.

The best arrangement is the addition of an evaporator or heat exchanger, where in the exhaust steam from the engine is condensed, and the heat released by condensation is employed to evaporate steam from raw water. The pressure drop need be but a few pounds.

It is true that the introduction of steam directly into vats hastens the process both by the agitation set up by the steam and by the reduced temperature difference between the steam and water, as compared to the 10 deg. or more needed when closed coils are used. But if ample coil surface is provided the latter objection disappears.

Steam consumption is, however, not the only thing to be considered. First cost, available space and spare capacity when considered may entirely alter the choice For example, two bleeder turbines each having capacity to generate the entire plant load and supply the process steam would provide 100 per cent spare capacity. To obtain this with condensing and non-condensing units three machines would be necessary unless both the condensing and non-condensing engines each had sufficient capacity to carry the entire power load. This, however,

would be uneconomical, since during the majority of the time these units would operate at half load. Thus although the bleeder turbine plant would have a greater steam consumption its lower first cost and smaller space requirement often would make it a more economical arrangement.

Where, over a day, the total process steam balances the power steam serious study should be given to the steam accumulator. If the operation cycle extends over two hours or less, the increase in engine back pressure by reason of the rise in the accumulator pressure will be slight. Consequently the steam rate of the generating unit will not vary to any great extent.

Various arrangements may be had by proper choice of accumulator capacity and piping layout. Best results are obtained when two process pressures are needed, as in paper mills using 110 lb. in the digesters and 20 lb. pressure on the paper rolls. Here the accumulator withdraws steam at 110 lb. and feeds it back either to the lower stages of the turbine or to the lower-pressure process main.

Special Conditions Require Special Layouts

Numerous other hook-ups with the accumulator have been worked out. The accumulator, while expensive, will cost less than a combination condensing and non-condensing steam plant capable of carrying the same load variation. It has, in some installations, a marked advantage in that no heat is lost to the condenser.

When process steam at several pressures is required, the multi-stage bleeder turbine is of particular advantage. Steam turbines may be provided with automatic regulators and maintain a constant pressure at each of the bleeder openings.

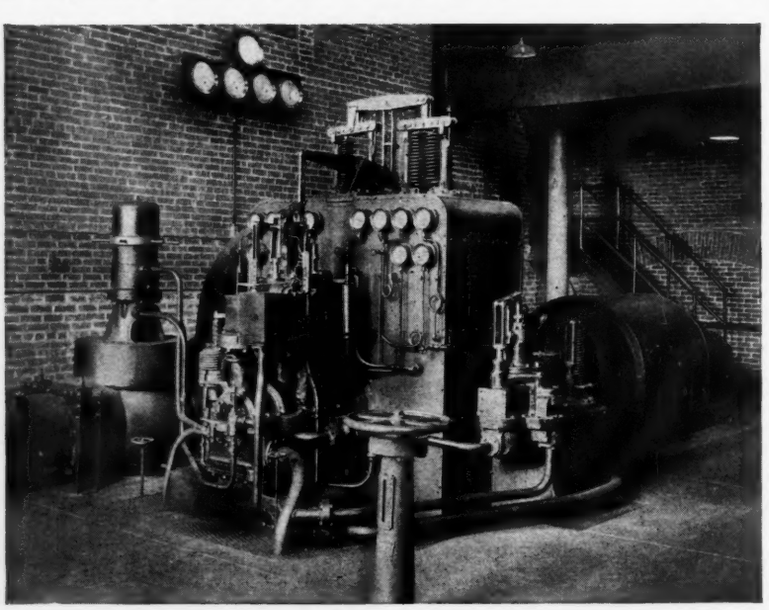
Additions to existing plants frequently require special units. Consider a plant, for example, in which back-pressure units exhausting to process were originally installed. In this plant the power load has increased faster than the demand for process steam. Therefore, in order to meet the power requirement, some of the exhaust from these units is lost to the atmosphere. This wasteful condition could be remedied by the installation of a mixed-pressure bleeder turbine, which would allow any available excess of low-pressure steam to flow into the turbine and do work, as well as allow bleeding of steam at the pressure existing in the low-pressure main.

As another example of special turbine application, consider a plant that has a battery of boilers in good condition generating steam at 150 lb. for general use. Process steam is used at 20 lb. Both the power and process-steam loads have increased; but the power load has increased somewhat faster than the process-steam load. In order to secure a balance under these changed conditions it was found necessary to install new boilers, of 350 lb. pressure. To produce power by the pressure drop to 150 lb. and at 20 lb. an inverted bleeder turbine may be used. This is a regular bleeder turbine designed to bleed at 150 lb. and exhaust at 20 lb., but the bleeder valve and its controlling mechanism are arranged so that the bleeder valves will pass just enough steam to supply the demand for exhaust steam and maintain 20 lb. pressure at the turbine exhaust opening. Any excess not required at 20 lb. is thus forced out of the bleeder opening into the 150-lb. steam line, relieving the load on the 150-lb. boiler. Thus the 350-lb. boiler may be run steadily at the most advantageous ratings, leaving the 150-lb. boiler to handle fluctuation.

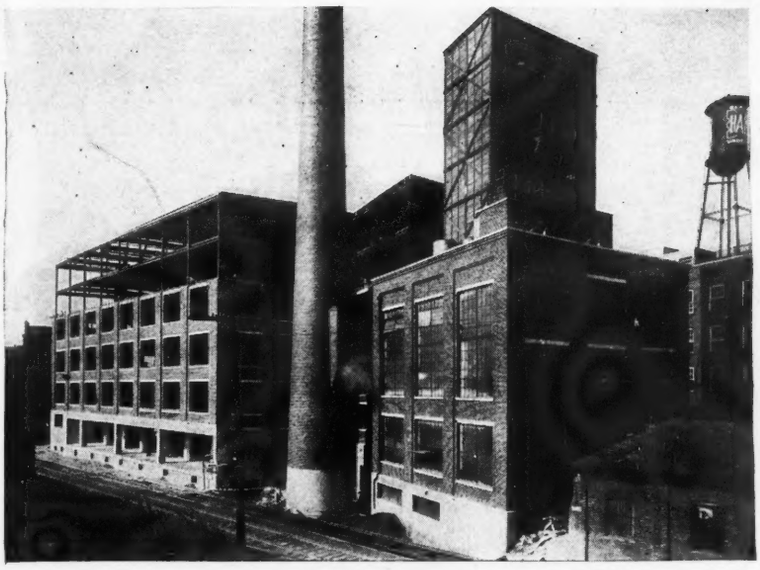
TOTAL STEAM FLOW TO GENERATING UNITS

Pounds steam bled hourly		Kilowatt load 100	200	300	400	500	600	700
20,000	T	20,800	20,800	20,800	20,800	20,800	22,200	23,700
	E	20,000	20,000	20,000	20,000	20,000	21,600	22,700
	ET	20,000	20,000	20,000	20,000	20,000	21,500	23,200
18,000	T	18,800	18,800	18,800	18,800	19,500	21,300	22,500
	E	18,000	18,000	18,000	18,000	18,000	21,100	21,400
	ET	18,000	18,000	18,000	18,000	18,000	20,300	21,800
16,000	T	16,800	16,800	16,800	16,800	18,300	19,900	21,200
	E	16,000	16,000	16,000	16,000	17,000	18,900	20,300
	ET	16,000	16,000	16,000	16,000	17,500	19,000	21,600
14,000	T	14,800	14,800	15,500	15,500	17,200	18,600	20,000
	E	14,000	14,000	14,000	14,000	16,200	17,500	19,100
	ET	14,000	14,000	14,000	14,000	16,300	17,800	19,300
12,000	T	12,800	12,800	12,800	14,400	15,900	17,200	18,500
	E	12,000	12,000	12,000	13,200	15,000	16,500	18,300
	ET	12,000	12,000	12,000	13,700	15,200	16,600	18,000
10,000	T	10,800	10,800	11,600	13,300	14,600	16,000	17,200
	E	10,000	10,000	10,000	12,500	13,900	15,500	17,600
	ET	10,000	10,000	10,000	12,700	14,200	15,600	16,800
8,000	T	8,800	8,800	10,500	12,000	13,500	14,900	16,000
	E	8,000	8,000	10,000	11,400	13,100	15,100	17,400
	ET	8,000	8,000	10,200	11,700	13,200	14,500	15,700
6,000	T	6,800	7,800	9,300	10,800	12,000	13,300	14,600
	E	6,000	7,200	9,000	10,600	12,500	14,700	17,000
	ET	6,000	7,800	9,300	10,800	12,200	13,500	14,700
4,000	T	6,800	6,500	8,000	9,400	10,900	12,000	13,500
	EE	4,700	6,700	8,200	10,000	12,100	14,400	16,700
	ET	5,500	7,000	8,500	10,000	11,200	12,500	13,700

T—bleeder turbine; E—one condensing and one back-pressure engine; ET—a condensing turbine and a back-pressure engine.



In the Franklin Sugar Refinery at Philadelphia, Pa., this bleeder type turbine has been installed, resulting in a marked reduction in the steam consumption of the refinery



Power and Industrial STEAM PLANT

BUILT FOR THE P. H. HANES KNITTING COMPANY

By P. L. Holland
Mechanical Engineer,
Mees & Mees, Inc., Consulting Engineers

THE P. H. Hanes Knitting Company, Winston-Salem, N. C., has recently put in service a power plant designed for the production of power as a byproduct from the steam required for process work, such as dyeing, bleaching, finishing, heating and cooking. The economies attained, which are typical of what may be done in other factories, make this plant of interest.

Prior to the construction of this plant electrical power was purchased, and steam for process work was obtained from a battery of Manning vertical boilers, totaling 6,500 sq.ft. of heating surface, located on the site of the new power house and industrial building. This old boiler plant had depreciated to a large extent and was overloaded to the limit. During the latter part of 1927 a complete study was made of the operating conditions in the manufacturing plant, as to steam requirements, power demands, cycle of operations and the coincidence of power- and steam-peak demands. The purpose of the investigation was to determine whether to rebuild the low-pressure boiler plant or to install high-pressure boilers and a bleeder-turbine unit. The conclusions drawn from this study indicated the advisability of constructing a complete modern high-pressure plant.

Due to the urgent need of more floor space in the manufacturing plant, the owners decided to construct a new industrial building adjacent to the new power plant on property then occupied by old buildings ranging from one to five stories in height.

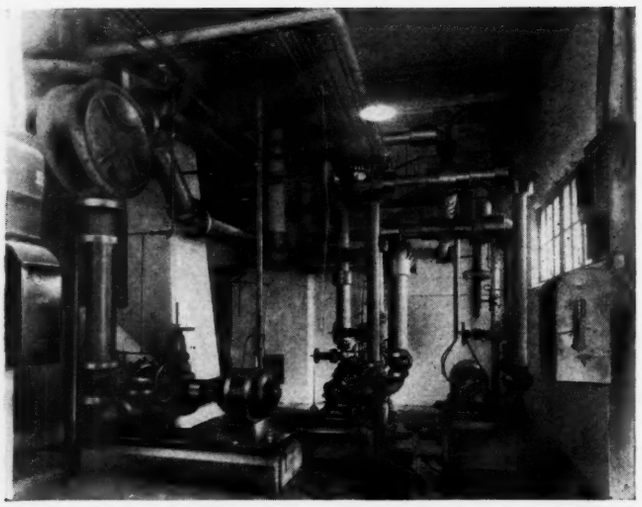
A recent combination of process steam and power, that of the P. H. Hanes Knitting Company, is discussed by one of the engineers who designed the plant. The savings obtained are representative of those possible in many other textile mills through intelligent engineering and management

It was necessary to carry on considerable demolition work, build the new structures step by step and make the cut over from the old sources of steam and of electrical power to the new plant without interruption to manufacturing operations. Consequently, the construction of this plant offered numerous difficulties and required considerably more time than was anticipated. An additional difficulty encountered was the necessity of piling all foundations under the power house, chimney, coal trestle and the industrial building. The latter building, three stories of which extend over the turbine room, is not yet completed.

The buildings consist of steel framing, brick walls, concrete floors and roof in the power house, as well as mill-type flooring and tar-and-gravel roofing on the industrial building. The concrete roof of the boiler room serves as a sump tank for a 16 x 30 x 50-ft. combined forced- and natural-draft cooling tower mounted above it. The location of the cooling tower on the power house roof was necessitated by the need for saving space.

The capacity of the new plant was fixed at approximately 60 per cent more than the demands at that time; this increase was to provide for undeveloped property nearby, assuming that the power and steam requirements per square foot of floor space would average the same as in the plants already constructed. The wisdom of this provision is already evident in an increase in power consumption of over 25 per cent, which has resulted from a large increase in output shown by this company this year.

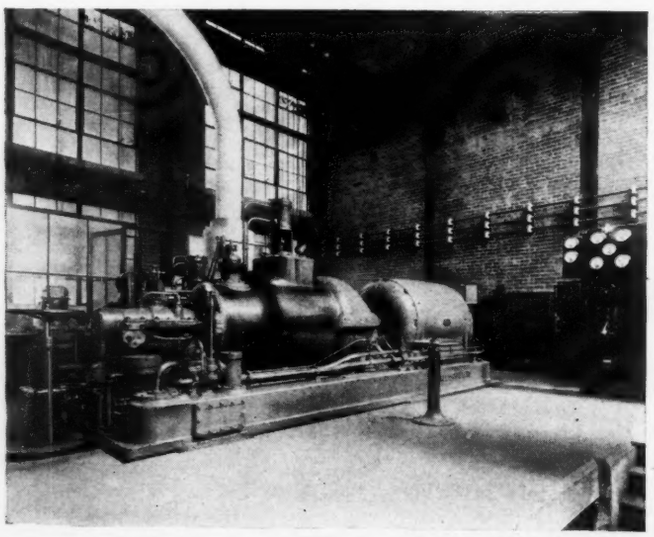
For the maximum operating pressure of the boilers 300 lb. gage was chosen as being sufficiently high for



Compact pipe lines in the turbine room basement and the boiler feed pumps

economical production of steam and satisfactory turbine performance under present and prospective future load conditions, and not too high for operation of the station auxiliaries, both turbines and reciprocating engines, at the boiler pressure. The necessity of low-pressure mains and reducing valves was thus obviated to the material advantage of the plant.

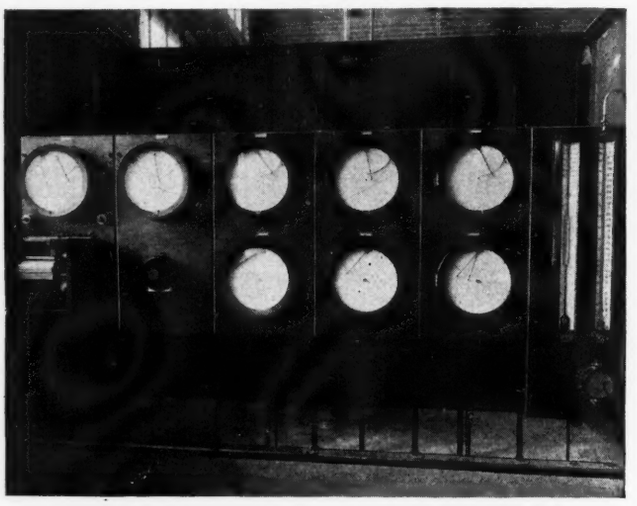
The boilers are equipped with superheaters located in the first bank of tubes, being partly radiant and partly convection type, thereby maintaining practically constant superheat. The steam pressure is controlled by means of a damper in the outlet of the forced-draft fan and operated by a step-action regulator connected to the main steam header. It has been found that pressure can be maintained practically constant regardless of the steam load fluctuations, which vary widely. The forced-draft blower is driven on one end by a slip-ring motor with a 50 per cent speed variation, and on the other end by a steam turbine the governor of which permits a wide variation in speed. In cases of great changes in the station load, either process steam or electrical, the speed of blower may be changed to assist in maintaining a constant boiler pressure.



View of the turbine room

The boilers are designed for continuous operation at 250 per cent of rating and may be operated at 300 per cent for four hours. Only one boiler is required to carry the full load of turbine-generator with the present peak process steam load. A boiler and furnace efficiency of 80 per cent has been obtained in regular plant operation and 12.69 per cent CO_2 has been shown for the ten-hour day-load period, which, in view of the extreme steam load fluctuations, must be considered good.

At present the boilers are being operated at 275 lb. gage and steam is delivered to the turbine at a pressure of 265 lb. gage and at a total temperature of 590 deg. F. Steam is bled from the turbine at 30 lb. gage for process work, embracing dyeing, bleaching, heating and cooking. This process pressure was selected as being the lowest that could be used without increasing the radiation areas in a considerable part of the machines then in use. As fast as coils are replaced in these machines greater radiation is being provided, and in the near future the process



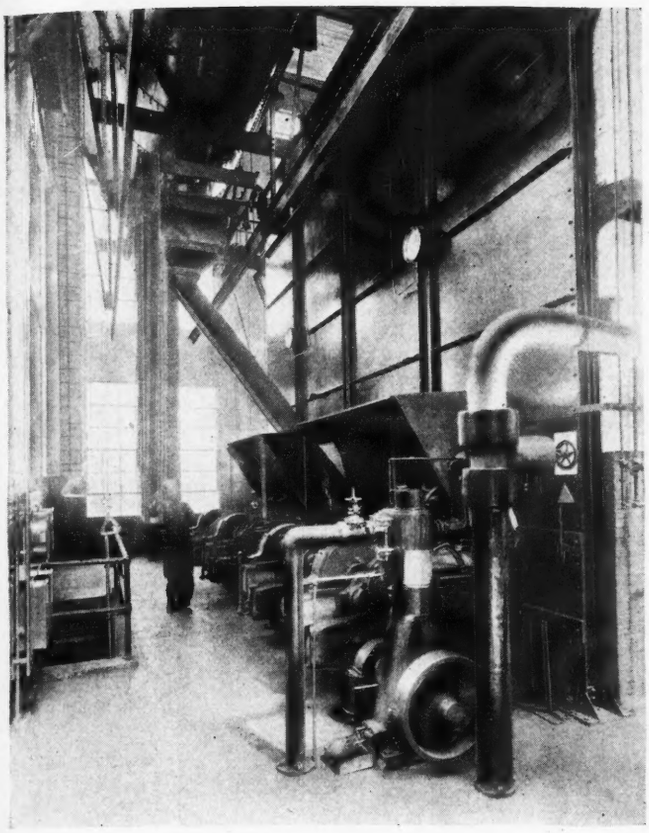
Instruments record steam to all departments for the engineer's information

pressure will be lowered considerably, the turbine having been designed to bleed at a pressure as low as fifteen pounds.

In order to maintain pressure in the process line when bled steam is not available in sufficient quantities or in case of generator shutdown, a bypass is provided from the main steam header through a 300- to 30-lb. reducing valve to the process line.

The steam bled from the turbine is normally superheated from 80 to 125 deg. F., and the steam passing through bypass may reach a temperature as high as 580 deg. F. In order to desuperheat to saturation all the steam that may be required in the process work a cartridge type desuperheater is provided in the process line beyond the junction of bypass and bleeder lines. The capacity of this desuperheater is sufficient to take care of the steam when all process steam is bypassed through the reducing valve. All instruments required for continuous tests are included in the plant's equipment, and daily records are made of the outputs.

Coal is fed by gravity from the overhead bunkers to a traveling weigh larry which discharges into the stoker hoppers. Boiler output, CO_2, flue-gas temperatures and draft are indicated on instruments mounted in the boiler room. The recording elements of the CO_2 and flue-gas temperature instruments, with recording flow meters on



The boilers are stoker fired

all steam lines, recording pressure gages and recording thermometers, are mounted in the engineer's office in the turbine room, and the feed-water heater is equipped with a recording V-notch meter, also mounted in the office.

In the design of the plant not only efficient operation but also ease and convenience in maintenance were kept in mind. The layout of the equipment and piping is such that any piece of apparatus and almost any section of piping can be taken out without disturbing anything else.

The idea embodied in the slogan "Use the steam twice" is applied to all water used in the plant. All hot-water drains are carried to the feed-water heater. All cold-water drains from uncontaminated sources, such as the turbine glands, oil cooler, radojets and overflow from cooling tower sump, are carried to a tank in the basement. A small motor-driven float-controlled pump, whose delivery pressure is slightly higher than the maximum pressure in the city mains, takes its suction from this tank and discharges into the cold-water main on the delivery side of a check valve, which prevents any back feed to the city mains. During the time this pump is in operation the only water drawn from the city mains is that for the turbine glands, which is required at approximately constant pressure for ease in regulation.

The operating conditions in this plant are extremely severe for a bleeder-type machine, the demand for process steam being zero during approximately eight hours at night and varying from a few thousand pounds to the maximum bleeding limit during the day. But even under these conditions the record of the plant to date is highly satisfactory. As compared to the same period last year, in May, June and July, the power and process steam demands have been approximately 25 per cent greater, while the total coal consumption has been only 11 per cent greater than that required last year for the process steam alone.

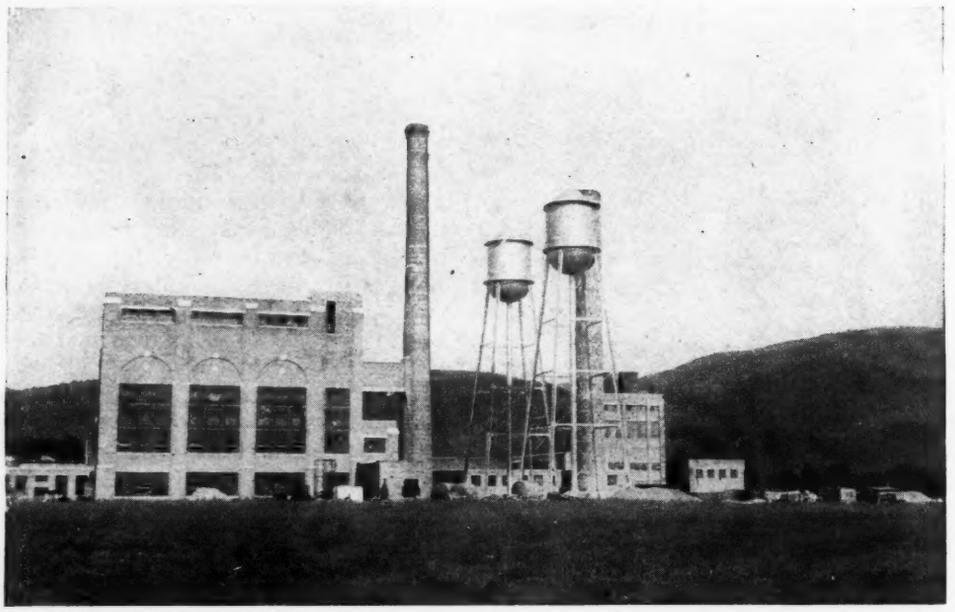
This plant was designed by and installed under the supervision of Mees & Mees, consulting engineers, Charlotte, N. C.

Engineers attending the National Convention of the N.A.P.E. at Chattanooga will find the Riverbend steam plant of the Duke Power Company, and the Pigeon River hydro-electric plant of the Carolina Power and Light Company worth visiting. For others of its readers *Power* will cover these two plants in the Sept. 3 number.

Principal New Power Plant Euipment of the P. H. Hanes Knitting Company

Boilers, two, Heine V-type, 4-drum, 4,930 sq.ft. water tube, designed for 300 lb. and 200 deg. F. superheat; furnace volume above fuel bed 1,140 cu.ft. each; ratio furnace volume, cu.ft. to boiler heating surface sq.ft., 0.232; effective grate area, 90 sq.ft. each; ratio boiler heating surface to grate surface, 54.8	Combustion Engrg. Corp.
Stokers, two, five-retort, 90-sq.ft. underfeed, with single-roll clinker grinders	Riley Stoker Corp.
Forced draft blower, one, 29,000 c.f.m., driven by 50-hp. G. E. slip-ring motor and a 50-hp. G. E. turbine	American Blower Co.
Soot blowers	Diamond Power Spec. Corp.
Steam purifiers, Tracyfiers in each boiler	Blaw-Knox Co.
Blow-off valves	
Ash ejector, steam-jet type, discharging into plate-steel, brick-lined overhead bunker	Hogan Corp.
Coal-handling equipment, one 60-ton catenary-type overhead bunker; V-bucket elevator, which hoists and distributes coal along the bunker	Weller Mfg. Co.
Feed-water heater, open type, with V-notch meter	Cochrane Corp.
Feed pumps, two, 5-stage, 125-g.p.m., 400-lb. head, centrifugal; one direct connected to motor and one direct connected to a turbine	Allis-Chalmers Mfg. Co
Feed water regulator, 3-in., 400-lb. type S, excess-pressure	Swartwout Co.
Turbine, one, 1,000-kva., 240-volt, 3-phase, 60-cycle, 3,600 r.p.m., with direct-connected exciter; 275 lb. and 200 deg. superheat at throttle, bleeding at 30 lb. gage	Allis-Chalmers Mfg. Co.
Condenser, one, 1,300-sq. ft. surface type, with twin radojet vacuum pumps, centrifugal circulating and condensate pumps	C. H. Wheeler Mfg. Co.
Cooling tower, one 16x30x50-ft. tower equipped with two 12-in. fans and natural-draft doors	C. H. Wheeler Mfg. Co.
High-pressure valves	Chapman Valve Co. Edward Valve Mfg. Co. Lunkenheimer Co.
Reducing valves, with master control operated by city water pressure, to reduce steam from 300 to 30 lb. gage	Swartwout Co.
Instruments, steam-flow meter, CO_2 recorders, flue-gas temperature recorders, recording thermometers and pressure gages	Brown Instrument Co.

Process Requirements Dictate Power Plant *Design*



ALTHOUGH BOILER PRESSURES OF AROUND 450 LB. *are coming into more general use in industrial power plants, the Industrial Rayon Corporation's new factory at Covington, Va., finds that 250 lb. at the turbine throttle gives the most economical heat balance. This emphasizes the truth of the oft-repeated statement that when building a power plant an industrial organization cannot view the problem merely as one of power generation. If the greatest efficiency is to be obtained, the process demands must be considered simultaneously.*

NOT ONLY do the process requirements of a particular industry need to be considered, but likewise the demands created by the locality of the mill are of great importance. In rayon mills in states below Virginia climatic conditions entail but a small heating load in the winter; other localities have atmospheric conditions necessitating less air conditioning. These often are of such importance as to indicate a boiler pressure and equipment quite foreign to what one might have anticipated.

Undoubtedly 450 lb. boiler pressure would have lowered the steam rate of the turbines, but during the summer it would have entailed the use of some live steam and a large amount during the winter. In Covington the winter temperature is moderately low, reaching the freezing point for periods of a week at a time. Heating of the building becomes vital, both for the benefit of the employees and to insure the high quality of rayon yarn. These heating requirements may be said to have been the determining factor when choosing the best boiler pressure for the Covington plant.

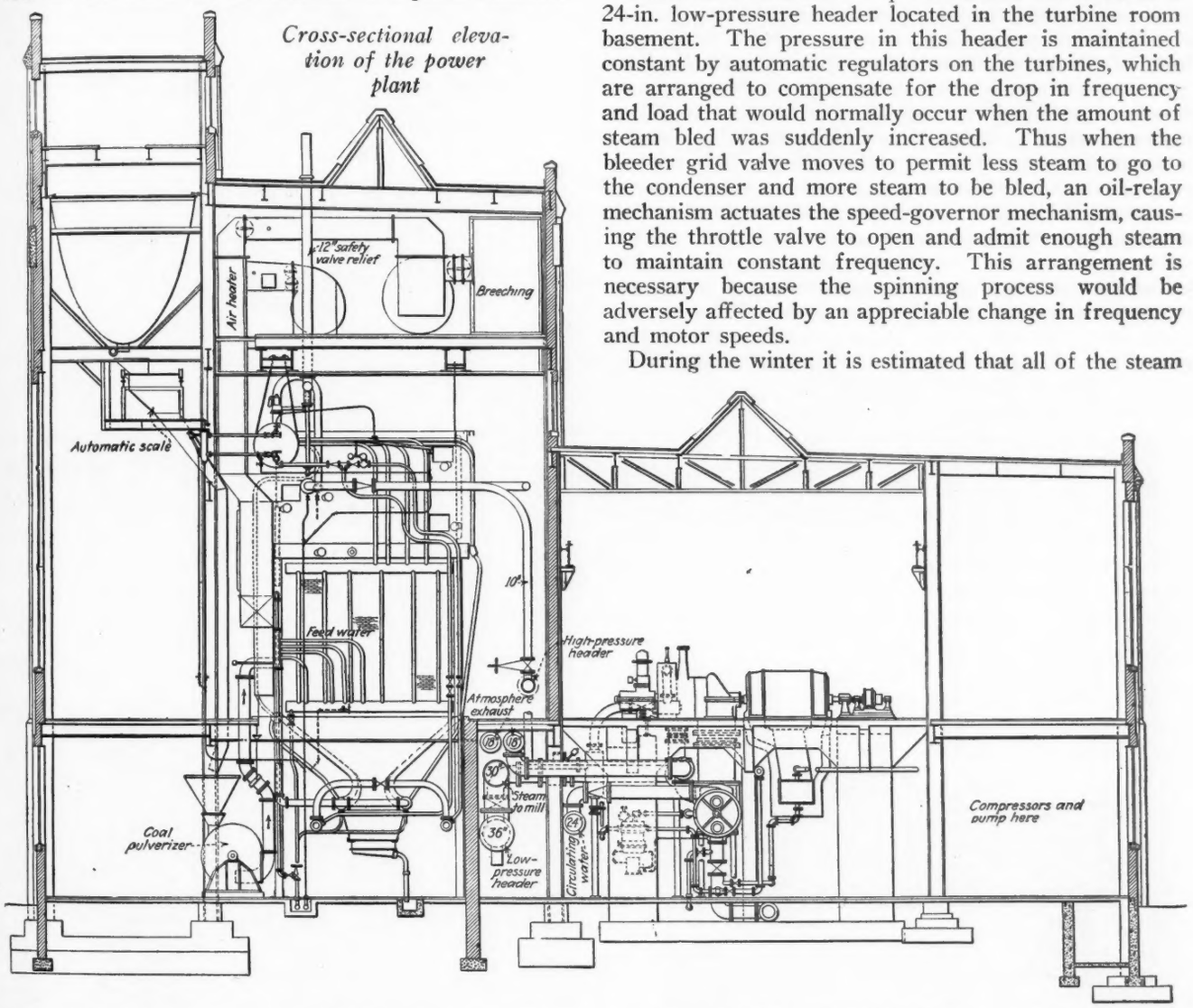
This plant uses steam at 20 lb. gage in the dryers, air-tempering and other processes, the average hourly consumption ranging from 50,000 to 60,000 lb. The bleeder type of turbine was chosen as the power-generating unit, as its low first cost and maintenance compared with reciprocating engines more than offset the slight steam savings possible with engines.

A large amount of hot water is required for yarn-washing and bleaching. There were three ways of obtaining this: cold water could be heated either by live steam or by steam bled from the turbines, or, as the third method, the turbine-condenser cooling water could be used. The first method eliminates opportunity of generating power with the same steam; the second method, while satisfactory during periods when the maximum amount of steam that could be bled is greater than the process-steam needs, could not be used economically in winter, as the added heating load not only called for the maximum amount of bled steam but also for a large amount of live steam.

The best solution was to use the turbine-condenser cooling water, with the vacuum in the condenser carried at 26 in. to give a water temperature of approximately 120 deg. F., which is hot enough for washing purposes. During the summer, then, the process steam takes about one-half the maximum bleeder output, and the remainder

of the steam passing through the turbine gives up its heat to the cooling water in the condenser. Of this water, one-half is used in the processing and the remainder is lost to a spray pond. But in winter all of the turbine bleeder output is used, reducing the condenser heat supply to a point where all of the cooling water can be utilized in the mill. If a higher pressure, of, say, 450 lb., had been chosen, the turbine efficiency would have been higher and the steam input smaller, which with the same bleeding or draw-off would have reduced the steam to the condenser to a point where for six months of the year the condensing water would have been insufficient for the process needs.

Cross-sectional elevation of the power plant



The best plan was to arrange the prime mover to bleed in the summer for:

1. Heating coils in the yarn dryers.
2. Some heating of process water.
3. Boiler feed water heating.

In winter the steam bled would meet the following demands:

1. Heating coils in yarn dryers.
2. Heating process water.
3. Boiler feed water heating.
4. Heating of the factory.

This power plant is unusual in that a large part of the power-consuming machinery is located in the power house itself. The load, of 2,300 hp., is made up of ammonia compressors handling the brine-cooling system used in the mill, air compressors supplying air for cleaning purposes and for the viscose tanks, vacuum pumps, fire pumps and general-service water pumps.

To satisfy present mill requirements for power and process steam, and having in mind future additions to the mill, as well as the necessity for breakdown service, two condensing bleeder turbines have been installed, each driving a 3,000-kw., 480-volt, 60-cycle, 3-phase alternator. One of these units is capable of generating all of the power required by the mill at present.

Steam is bled at 20 lb. pressure and delivered to a 24-in. low-pressure header located in the turbine room basement. The pressure in this header is maintained constant by automatic regulators on the turbines, which are arranged to compensate for the drop in frequency and load that would normally occur when the amount of steam bled was suddenly increased. Thus when the bleeder grid valve moves to permit less steam to go to the condenser and more steam to be bled, an oil-relay mechanism actuates the speed-governor mechanism, causing the throttle valve to open and admit enough steam to maintain constant frequency. This arrangement is necessary because the spinning process would be adversely affected by an appreciable change in frequency and motor speeds.

During the winter it is estimated that all of the steam passing the turbine throttle will have to be bled, except for a small amount necessary to cool the low-pressure stages of the unit. During the summer, because of the absence of the building heating load, the demand for low-pressure steam will be much less, as has been explained.

Although the plant is located near the headwaters of the James River, the river water, contaminated by paper mills further up the steam, cannot be used either in the power plant or for any of the mill processes.

A dam was constructed across a mountain stream about a mile from the plant, and the water from this reservoir was piped to a 3,000,000-gal. per day coagulation and sand-filter bed. Filtered water for plant use is collected in a concrete underground cold-water well at the power house.

Condenser circulating water is taken from the cold

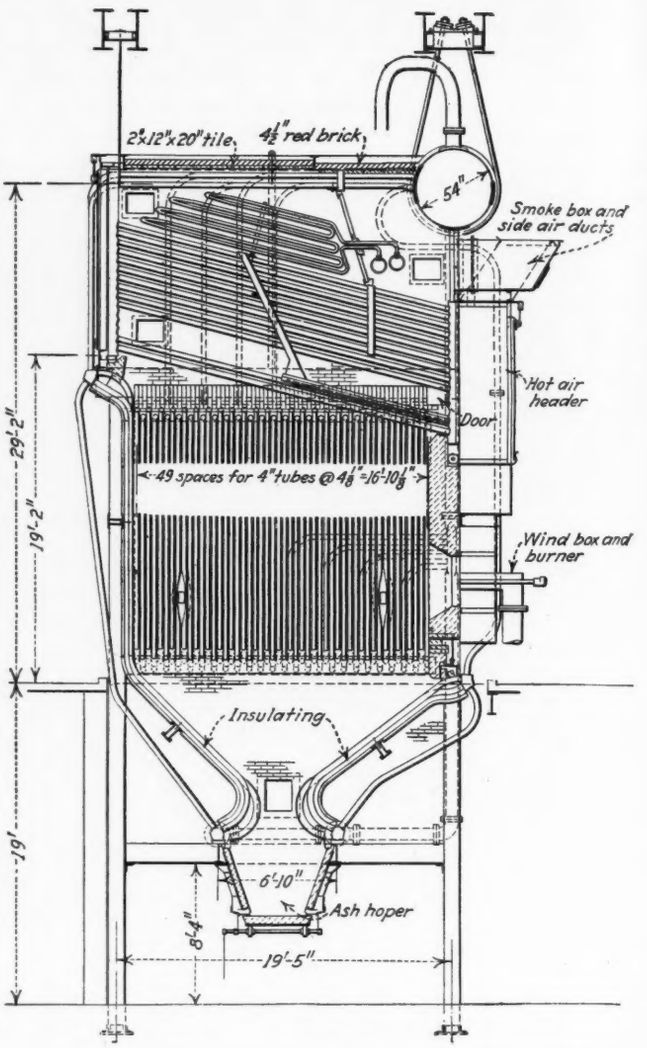
well and pumped through the main condensers by two 5,000-gal. centrifugal pumps. These pumps are so piped that each may serve either condenser. Circulating water is discharged from the condensers at about 120 deg. and is forced by two 2,500-gal. booster pumps to the mill, where it is used for washing and other process requirements.

During the winter a relatively small amount of circulating water is required to condense the steam, and the demand for hot water is sufficient to use all of this circulating water. During the summer, however, considerably more water is required by the condensers and only about half of it is used in the plant. The other half is cooled in a spray pond and returned to the cold-water well.

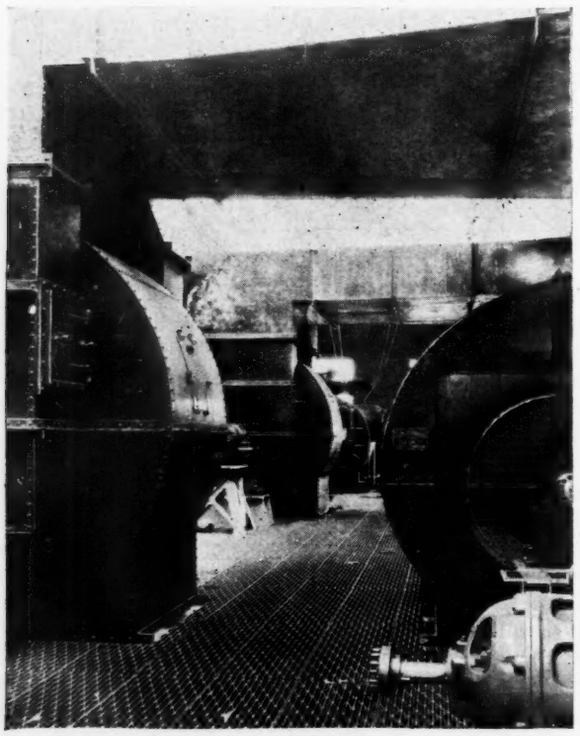
Before it reaches the condenser a portion of the circulating water is bled off to fin-type generator-air coolers, after which it is used in the turbine-oil coolers. An emergency city water connection is also available for the oil coolers.

Exhaust steam from the turbines is condensed in two-pass condensers, and the condensate is pumped first through the inter- and after-condensers of steam-jet air pumps and then to a deaërating feed-water heater located on the fan floor above the boilers. Make-up water, after passing through the heat exchanger of a continuous blow-down system, is also delivered to the heater. Steam for heating the water is supplied from the low-pressure header through an 18-in. line, and in addition all of the high-pressure traps discharge into the heater.

A 10-in. line carries the water from the heater to the boiler-feed pump suction header. Three pumps have been installed, one 420 g.p.m. turbine driven, one 420 g.p.m. motor driven and one 210 g.p.m. motor driven. Normally the boilers are fed through automatic feed-water regulators, but in case of emergency they may be fed by hand through an emergency feed-water line. The hand-feed valve is conveniently located at the boiler room operating floor level.



The boiler furnaces have plain-tube water walls



Induced- and forced-draft fans are above the boilers

About 15 per cent of the total feed water is make up, which is treated in zeolite softeners and delivered to the feed-water heater.

An emergency 75-kw. turbine-driven exciter in addition to supplying exciting current in case of trouble with the direct-connected exciters, furnishes energy for emergency lights in the power house. This turbine exhausts to the atmosphere.

While Covington is not far from the West Virginia coal fields, coal is not cheap, which led to the desire to install firing equipment that could handle the cheapest coal available, with the greatest flexibility. Unit pulverizers seemed to offer marked advantages, one being a decrease in boiler room labor, and as the mill will operate 24 hr. daily during the entire year, this type of equipment should show a high efficiency.

The over-all efficiency of the boiler, furnace, superheater and air heater at various steaming rates as used by designers in laying out the plant is as follows:

Pounds Steam per Hr.	Rating, Per Cent	Efficiency, Per Cent
25,000	120	86
45,000	215	83.2
70,000	335	83.5

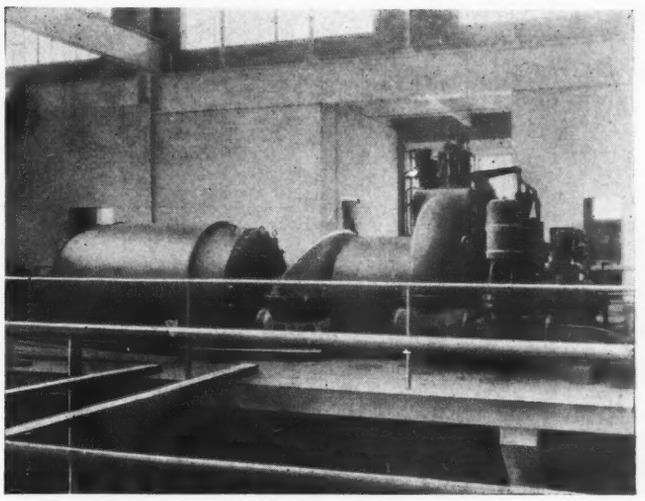
Coal received by rail is dumped into a track hopper and fed directly to a 75-ton coal crusher. The crushed coal is raised to the bunker room floor by a bucket ele-

vator, which delivers to a flight conveyor for distributing to the bunkers.

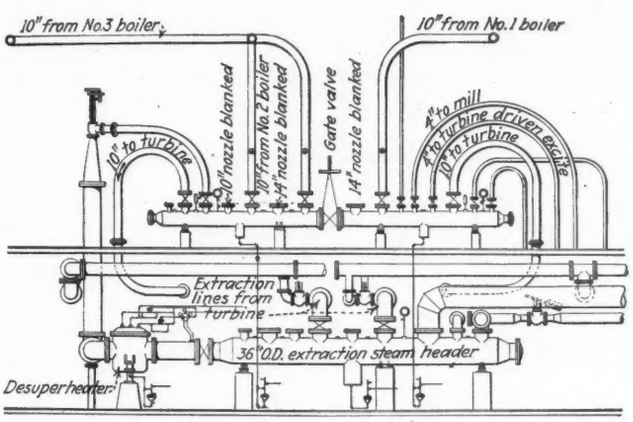
Three pulverizing mills, one for each boiler, are on the ground floor. The crushed coal from the bunkers, just below the roof, passes through automatic coal scales, one serving each pulverizer. Each pulverizer discharges into a single burner placed in the furnace front, as it is expected that the single burner will be able to handle all load variations and operate satisfactorily at the lowest boiler-evaporation rate. No cross-connection permits a mill on one boiler to feed to another furnace, as might be required in case a pulverizer broke down while the stand-by boiler was dead.

In place of economizers, which were not justified because of the high feed-water temperature obtained by bleeding steam at 20 lb., tubular-type air preheaters are used. Induced-draft fans, one per boiler, driven by variable-speed motors, draw the flue gas from the boiler uptakes and force it through the air preheaters and out into the breeching; the latter discharges into a 200-ft. high by 10-ft. inside diameter radial brick stack. The air is sent through the heaters by forced-draft fans driven by variable-speed motors; and after leaving the preheaters passes down into wind boxes on the boiler fronts. Primary air ducts leave the lower part of these boxes and drop vertically to the pulverizers. Secondary air is admitted into the chamber around the burner.

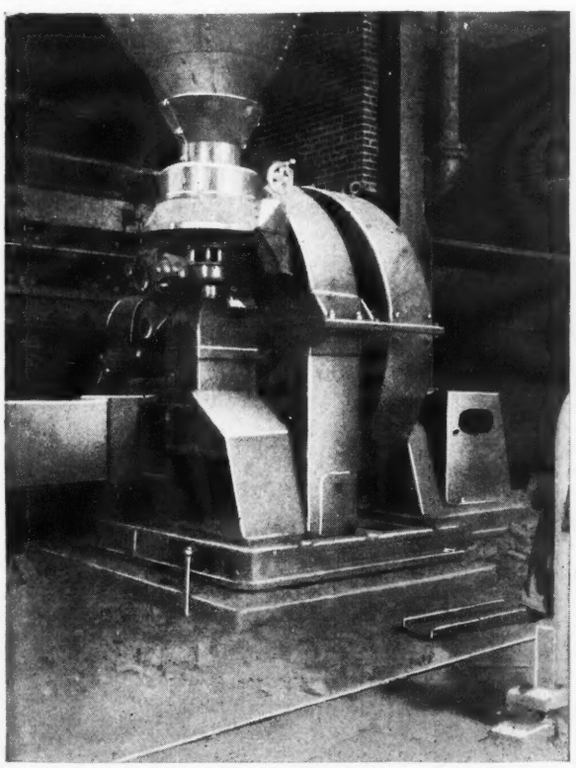
In designing the plant the engineers used values for the flue gas and air temperatures in and out of the air preheater, the air flow, CO_2 and draft at various rates of steaming, as tabulated below.



One of the turbines after erection



The high- and low-pressure headers with the several take-off lines and valves



One of the pulverizers, which are located on the ground floor

ESTIMATED GAS AND AIR QUANTITIES

Steam per hr., lb	25,000	45,000	70,000	70,000
CO_2, per cent	14	14	14	11
Air, lb. per hr	33,800	62,400	101,000	127,300
Flue gas, lb. per hr	36,900	67,900	110,000	136,300
Flue gas to heater, deg. F	480	550	655	655
Flue gas from heater, deg. F	236	291	376	382
Air to heater, deg. F	80	80	80	80
Air from heater, deg. F	319	334	363	352
Draft ton, in	0.15	0.52	1.67	2.17
Air friction, in	0.15	0.52	1.5	2.5

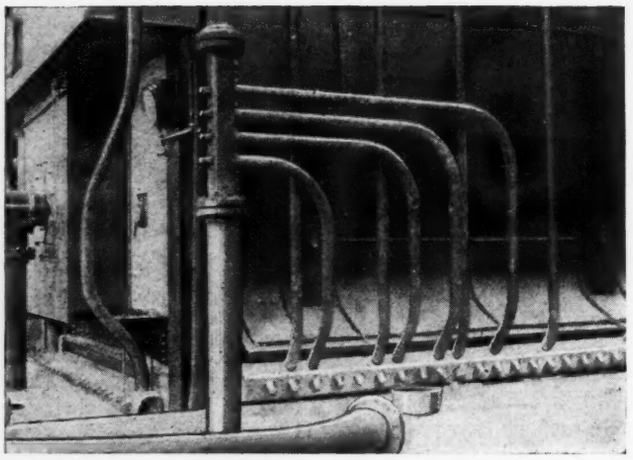
Three cross-drum boilers built for 300-lb. working pressure, each containing 6,570 sq.ft. of heating surface, have been installed. During the winter it is intended that three boilers will normally be in operation carrying the full load at about 225 per cent rating. If it becomes necessary to shut down one boiler for repairs, the remaining boilers will at times be required to produce about 70,000 lb. of steam an hour. Because of the high ratings to be carried and the use of pulverized fuel, it was felt that a plain refractory wall would not "stand up," and consequently each boiler is provided with plain-tube water walls on sides, back and lower part of the front. The tubes are placed so that there is but $\frac{1}{8}$ in. space between them, presenting to the furnace a heating surface almost totally water cooled.

The top headers of the walls are connected to the steam space of the boiler drum through curved tubes, and the lower headers connect with a downcomer, or circulating pipe, which enters the boiler drum below the water level. The header-to-downcomer connections for

the side walls are each made up of four tubes entering the header at intervals in order to distribute the water to the side-wall tubes. Headers and tubes make up the sloping sides, front and back of the ash hopper.

The ash hoppers are serviced by manually controlled ash gates, the ash being dumped into a lorry after wetting.

The boiler drums and headers are supported from large H columns which form a part of the building steel.



Connection to the furnace water walls

Each boiler has two safety valves on the drum, and one valve on the superheater; the three valves on each boiler unit discharge into a common header above the boiler, with a stack to the roof.

Steam leaving the boiler drum, at about 265 lb., enters the superheaters and emerges with a superheat of 175 deg. F., to enter an 18-in. high-pressure header at the rear of the boilers and set above the floor level. Below this high-pressure header is the 20-lb. header. It is connected to the high-pressure header through a desuperheater and piston-type control valve, the connections of the two headers being shown on page 327. These headers are forgings, with each end swaged down to a flanged opening, and the several nozzles are forge-welded to the headers. Van Stone joints, with composition gaskets, are used.

The Covington plant was designed by J. E. Serrine & Company, consulting engineers, Greenville, S. C., in cooperation with F. C. Niederhauser, vice-president, and L. J. Jordan, chief engineer of the Industrial Rayon Corporation.

POWER SERVICES

In the Covington Plant

If an industry is to manufacture its product at the lowest possible cost, there must be a coordination of the power and manufacturing departments. The modern trend in this interrelationship is strikingly shown in the Covington, Va., plant of the Industrial Rayon Corporation, which is designed to have a capacity of 6,000,000 lb. of rayon per year.

IN THE Covington mill the power plant not only supplies power to the many factory machines, but in addition supplies low-pressure steam and hot water for processing, refrigeration for the chemical department, fresh-water services, and conditioned air and ventilation for the several departments.

The manufacture of rayon is the industrialist's answer to the world's demand that there be no distinguishable difference between Bridget O'Grady and the Colonel's lady.

The humble silkworm, even working overtime, could not produce enough silk to provide the frocks and other paraphernalia that adorn the feminine world, and obediently the engineers and chemists created an artificial silkworm, which has developed into the enormous rayon industry.

Probably in no other industry do the chemical and mechanical engineers need to work in closer collaboration, as the perfection of the mill product depends upon correct air and steam pressures and upon uniform motor speeds.

The method by which a spruce tree becomes a skein of artificial silk is a combination of the lumbering, chemical and textile arts. In the Canadian pulp mills the spruce is converted into a cellulose base, and this is shipped in sheets to the rayon mill. There the sheet is soaked in caustic soda to mercerize it. Then it is placed in a filter press to remove the excess caustic. The pulp sheet is next put into beating machines, or Pfleiderers, where it is broken up into small lumps and moved into a ripening room, where it is kept in metal receivers at a definite low temperature for about 48 hrs. This room is equipped with brine piping.

The material, now an alkali cellulose, next goes to horizontal tumbling drums, where carbon bisulphide is added and the mass stirred until it becomes plastic, whereupon it is dropped into closed vessels in a room below, where it is put under a vacuum to remove the excess bisulphide gas. The substance is now called "cellulose xanthate." Both these machines are cooled by water, which has previously been chilled by brine in double-pipe coolers. It is now a pasty mass, in the trade called a "viscose." The next step is to place it in air-tight containers in the basement of the processing building, where it is aged; this room is held at low temperature by brine at 25 deg. F. The viscose, when needed, is forced by air pressure to the spin room, where the mass is extruded through minute holes into a sulphuric acid bath to form rayon thread.

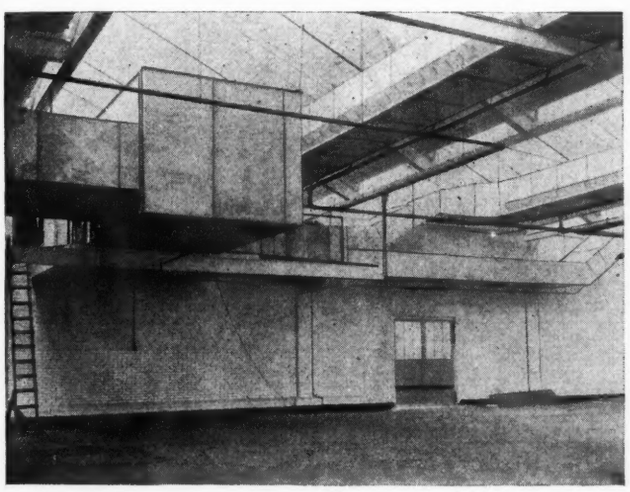
To supply the cold brine and the cold water there is a complete refrigerating plant in the basement of the

turbine room in the power house. This includes three horizontal inclosed-type double-acting ammonia compressors direct connected to welded-frame synchronous motors. The use of this type of motor will raise the power factor of the power system, which is made up, in the main, of induction motors. The compressors are filled with clearance pockets to permit adjustment of the compressor capacity with a constant-speed drive.

The ammonia gas leaving the compressors enters a header leading to two sets of multi-tube condensers. Condensing water comes from the clear-water well at the spray pond, having been lifted from the filter bed by a 2,160-g.p.m. centrifugal pump. From this well it is taken by the circulating water pump, put through the condensers and discharged into the cold-water well at the power house.

Brine for the process departments is cooled in two shell-and-tube coolers situated alongside the ammonia condensers, and is then forced into the brine line by a centrifugal pump in the turbine room basement. When ever possible all the pipe lines of the system are welded. To cool the water circulated in the process machines, brine is circulated through coolers in the mill basement.

As it is necessary that the air pressure in the viscose tanks be held without an appreciable variation, or else the

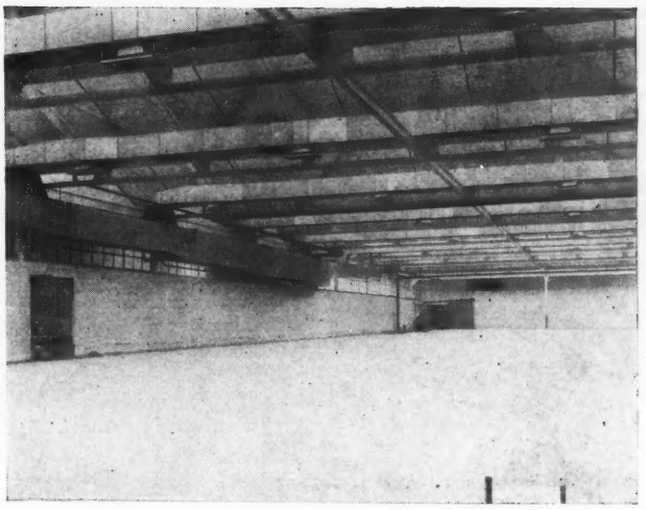


Heating units in the spinning room

threads will be irregular in diameter, two air systems are used, the second supplying air for general mill purposes. This plan entailed the installation of four cross-compound compressors driven through Texrope systems by 1,160-r.p.m. induction motors. These compressors have inter-and after-coolers; the cooling water for these and for the cylinder jackets comes from the same header as does the ammonia-condenser water. There are four air receivers on the power house roof.

To remove the vapors during the processing, two horizontal vacuum pumps are located in the turbine room basement. Motors running at 1,800 r.p.m. are connected to these pumps by Texrope drives. The water for the various mill purposes is handled by the general-service centrifugal pumps in the power house basement.

After the viscose material has been prepared, the process of making rayon is carried out in four steps: Spinning, twisting, bleaching and drying and finishing. There are two spinning rooms, each approximately 154 ft. wide by 176 ft. long; two twisting rooms, each about 154 ft. wide by 336 ft. long; and one finishing room.



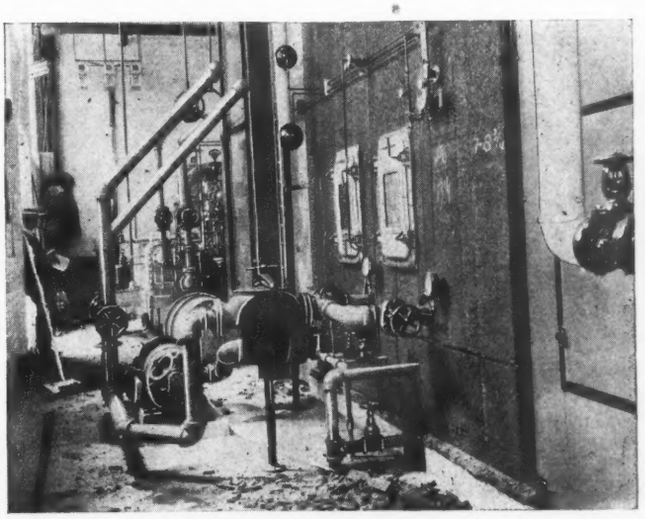
Air-conditioning ducts in the twist room

The rayon fibre during these processes is exceedingly hygroscopic and therefore sensitive to atmospheric moisture. If the air is allowed to become too dry, the fibre may become too brittle to be properly processed; or if too humid, the fibre may absorb enough moisture to affect its strength. Accordingly, careful regulation of temperature and humidity is required throughout.

Conditioning the rooms where spinning and twisting operations are performed is largely a problem of humidification.

Each of these rooms has separate air-conditioning equipment, consisting of air washer, fan, fresh-air filters, heating stacks and air-washer pumps. In each system part of the air drawn from the room, together with filtered fresh air, passes through the air washer, and at the washer outlet the remainder of the air from the room mixes with the washed air. The proportion of return air not passing through the washer is regulated by dampers under the control of a hygrostat. The amount of fresh air passing through the washer is controlled by the temperature of the air leaving the air washer. The mixture of washed air and recirculated air is delivered by the fan through the duct system to the room being conditioned.

In each of the spinning rooms about 77,000 cu.ft. of

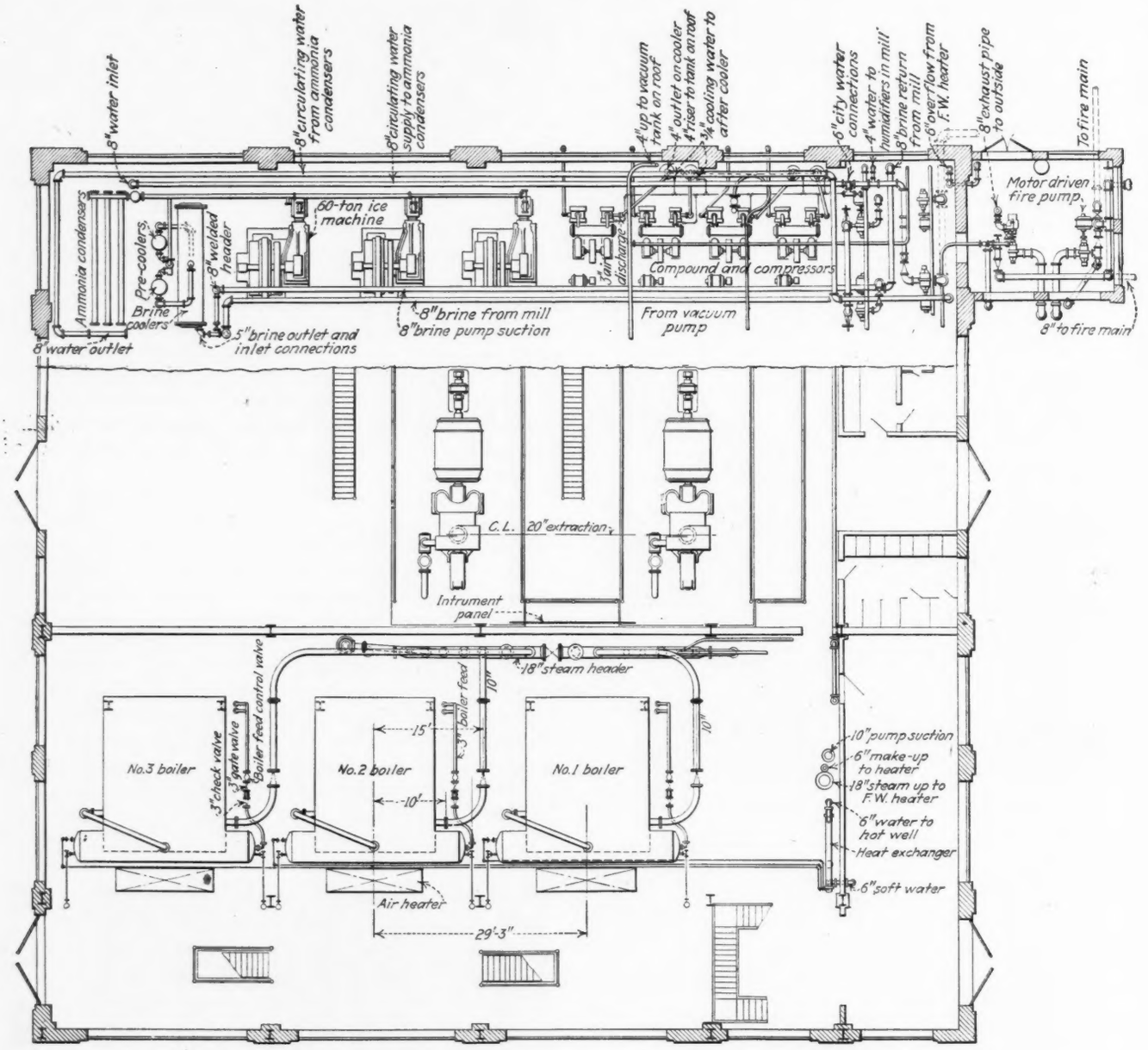


One of the air-conditioning units

conditioned air is supplied per minute, while the twisting rooms are each supplied with 44,000 cu.ft. During the winter the conditioning equipment will maintain a temperature of 70 deg. and 75 per cent humidity in the spinning rooms, and 60 per cent humidity in the twisting rooms. During the summer a wet-bulb temperature 9 and 16 deg., respectively, above the outside wet-bulb temperature can be maintained.

A typical arrangement of ducts is shown in the photograph of one of the twisting rooms taken before the

The process of spinning rayon fiber takes place under a bath of sulphuric acid, the fumes from which would become dangerous if allowed to escape into the room. Accordingly, all of the spinning machines are provided with ducts through which the acid fumes are exhausted by three fans having a total capacity of 224,000 c.f.m. These fans deliver the fume-laden air to a radial brick stack 8 ft. in diameter and 200 ft. high, the stack being necessary to prevent the acid from injuring the surrounding vegetation



Plan of power house, showing process auxiliary machinery

mill machinery was installed. A fine-mesh wire screen has been placed under all of the outlet openings in order to secure distribution and to prevent any foreign material from falling on the rayon fiber. Return air is taken out through an opening hidden by the inlet ducts. Through the large exhaust opening at the rear of the room air is drawn over heating stacks and delivered by a 35,000-c.f.m. fan to the adjoining spinning room. This fan and the heating equipment are used only during the winter and heat only one end of the spinning room.

In the finishing room the rayon is inspected and skeined. Here all of the rayon thread passes through the hands of girl inspectors. To prevent the thread from being soiled or otherwise damaged, an air condition must be maintained that will eliminate perspiring of the workers' hands. In addition, the humidity conditions must be such as to maintain not more than 10 per cent of moisture in the rayon. This is the commercial standard.

To effect this air conditioning a 75-ton motor-driven low-pressure centrifugal-type refrigerating unit was in-

stalled, which cools the water used in the air-washing equipment. During the summer the water in the air washer cools the supply air sufficiently to maintain a dry-bulb temperature in the finishing room not exceeding 82.5 deg., with a relative humidity of 60 per cent. During the winter, heating stacks at the fan and at the fresh-air inlet heat the air supply, maintaining 70 deg. dry-bulb and 60 per cent relative humidity. During these months it sometimes becomes necessary to heat the water for the air washer in order to obtain the desired humidity. For this purpose a mixing fitting has been provided whereby steam at 20 lb. pressure may be used to heat the water. This mixing fitting has also been installed at the other air washers.

Additional ventilating and heating equipment has been installed for such spaces as the shipping room, storage space, cafeteria and offices. A conventional two-pipe vacuum system is installed for office heating, the cast-iron radiators being located under the windows. In the cafeteria and shipping room the ventilating system is used for heating. The fin-type heating coils and fans are suspended from the ceiling.

The application of air conditioning to such manufacturing processes as rayon silk spinning is modern and permits the production of a suitable artificial silk thread without excessive inspection losses. While the system requires a small amount of attention, it operates automatically and regulates the air conditioners through the action of sensitive apparatus.

The successful operation of the mill depends upon the close co-ordination of the power house and the manufacturing departments.

Equipment Data on the Covington Plant of the Industrial Rayon Company

Boilers and Equipment

Boilers, three Hedges-Walsh & Weidner cross-drum; 6,570 sq.ft. heating surface; 4-in. dia. tubes, 20 ft. long 12 high, 22 wide. Working pressure, 300 lb. International Combustion Engrg. Corp.
Furnace walls, water cooled; 860 sq.ft. projected area per boiler, plain tubes ..... International Combustion Engrg. Corp.
Safety valves, three 4-in. and one 2½ in. per boiler ..... Consolidated Ashcroft Hancock Co.
Blow-off valves, six per boiler .. Yarnall-Waring Company
Water columns ..... Yarnall-Waring Company
Superheaters ..... Superheater Company
Soot blowers, seven per boiler, Diamond Power Specialty Corp.
Ashgates and hoppers ..... Allen-Sherman-Hoff Company
Boiler stop valves ..... Schutte & Koerting Company

Fuel Handling and Combustion

Coal crusher, 75 tons per hour ..... Link-Belt Company
Bucket elevator, 8x12 in. buckets .... Link-Belt Company
Distributing conveyor, drag flight .... Link-Belt Company
Coal scales, automatic, three; 4-6 ton per hr. capacity ..... Richardson Scale Company
Coal bunker, steel; 450-ton capacity ..... Virginia Bridge & Iron Company
Unit pulverizers, three, 8,500 lb. per hr; direct connected to 75-hp. Westinghouse motors ..... Riley Stoker Corp.
Burners, three, flare type ..... Riley Stoker Corp.
Furnace, 13 ft. x 18 ft. 6 in. x 22 ft. 6 in. high, 4,200 cu.ft. ..... Rust Engineering Co.
Insulation ..... Johns-Manville Corp.
Fire brick, Woodland .. Harbison-Walker Refractories Co.
Stack, radial brick, 200 ft. high, 10 ft. dia. ..... Rust Engineering Company
Forced-draft fans, three, 31,900 c.f.m. at 7.5 in., 1,152 r.p.m.; driven by 60-hp. Westinghouse variable-speed slip-ring motors ..... Green Fuel Economizer Co.
Induced-draft fans, three, 50,600 c.f.m., at 574 deg. F., 5.3 in. s.p., 572 r.p.m.; driven by 75-hp. Westinghouse variable speed slip-ring motors ..... Green Fuel Economizer Co.
Air preheaters, three, vertical tubular-type; 6,152 sq.ft. of heating surface ... Green Fuel Economizer Co.

Feed-Water System

Feed-water heater, deäerating type, 210,000 lb. per hr.; outlet temperature 258 deg. F., with 20 lb. steam ..... Elliott Company
Feed and process water softeners, three, vertical type; 280,000 gal. per 12 hr. each .. Permutit Company
Feed pumps. One, 3-stage, 420-g.p.m., 693 ft. head, 2,500 r.p.m.; direct-connected to a steam turbine ..... De Laval Steam Turbine Company
One, 4-stage, 420-g.p.m. 693-ft. head, 1,700 r.p.m.; direct-connected to 125-hp. squirrel-cage Westinghouse motor ..... De Laval Steam Turbine Company
One, 6-stage, 210-g.p.m. 693 ft. head, 1,750 r.p.m.; direct-connected to a 75-hp. Westinghouse motor .. De Laval Steam Turbine Company

Turbines and Equipment

Main units, two, bleeder-type condensing, with compensated bleeder regulators, 3,000 kw. 480-volt, 60-cycle, 3-phase; direct-connected 30-kw. 125-volt exciters. Westinghouse Electric & Mfg. Co.
Generator air coolers, U-fin type .. Griscom-Russell Company
Emergency exciter, turbine driven, 75 kw. 125 volts, 1,800 r.p.m. .. Westinghouse Electric & Mfg. Co.
Atmospheric relief valves ... Schutte & Koerting Company
Condensers, two, two-pass, 1,358 tubes ¾-in. dia. No. 18 gage, 15 ft. long, 4,000 sq.ft. ..... C. H. Wheeler Mfg. Co.
Air pumps, two, radojet duplex .. C. H. Wheeler Mfg. Co.
Condensate pumps, two, two-stage, 150-ft. head, 40,000 lb. per hr. driven by two 10-hp., 1,750 r.p.m. Westinghouse motors .... C. H. Wheeler Mfg. Co.
Circulating pumps, two, 5,000 g.p.m. 55-ft. head; direct-connected to 100-hp., 860-r.p.m. Westinghouse motors. De Laval Steam Turbine Company

Power Services

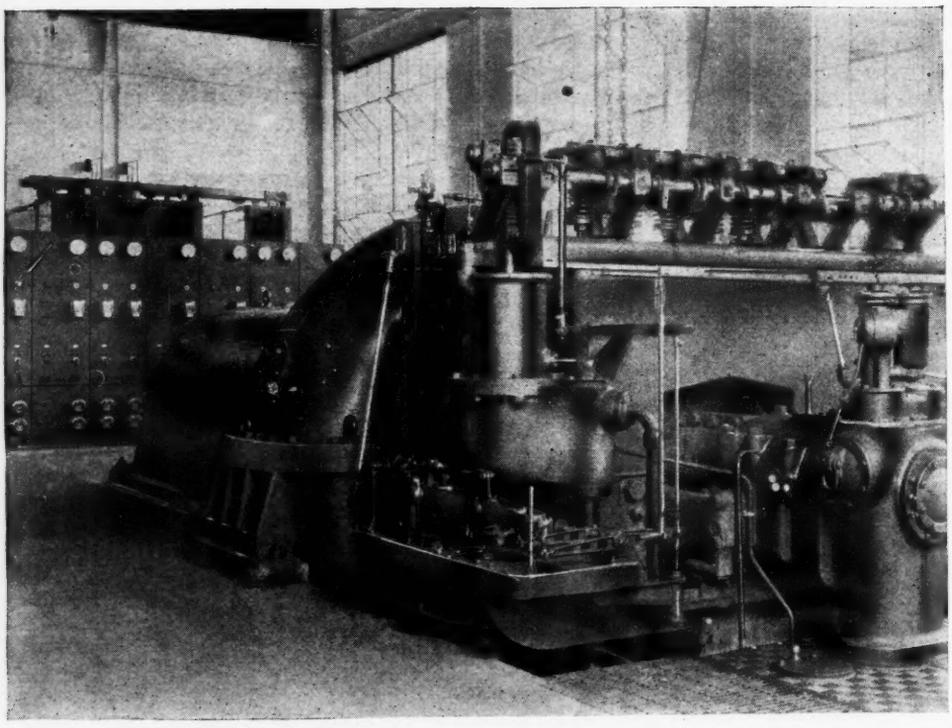
Raw-water pumps, two, 2,100-g.p.m., 115-ft. head, 1,750-r.p.m.; direct-connected to 100-hp. Westinghouse motors. De Laval Steam Turbine Company
Service pumps, two, 2,000-g.p.m. 65-ft. head 1,750-r.p.m.; direct-connected to 40-hp. Westinghouse motors .... De Laval Steam Turbine Company
Make-up pumps, two, 500-g.p.m. 135-ft. head, 1,750-r.p.m.; direct-connected to 25-hp. Westinghouse motors .... De Laval Steam Turbine Company
Booster pumps, two, 2,500-g.p.m., 100-ft. head, 1,750-r.p.m.; direct-connected to 100-hp. Westinghouse motors .... De Laval Steam Turbine Company
Fire pumps, two, 1,000-g.p.m. 231-ft. head; one direct-connected to a 110-hp. turbine, one to a 100-hp. motor .... De Laval Steam Turbine Company
Brine pumps, two, 900-g.p.m. 135-ft. head 1,750-r.p.m.; direct-connected to 50-hp. Westinghouse motors ..... De Laval Steam Turbine Company
Circulating water pumps for ammonia condenser, two, 1,125-g.p.m., 60-ft. head 1,750-r.p.m.; driven by 25-hp. Westinghouse motors ..... De Laval Steam Turbine Company
Ammonia compressors, three, 12 x 15-in. 60-ton capacity, 180-r.p.m.; driven by 125-hp. synchronous Westinghouse motors ..... I. P. Morris & De La Vergne, Inc.
Air compressors, four, 2 stage, 11 x 7 x 10-in., 327-c.f.m. capacity, with inter- and after-coolers, 80 lb. pressure, 300-r.p.m.; driven by 52-hp. Westinghouse motors ... Ingersoll-Rand Company
Vacuum pumps, two, 213-c.f.m., 24-in. vacuum, 240-r.p.m.; driven by 15-hp. Westinghouse motors ..... Ingersoll-Rand Company

Accessories

Desuperheater ..... Schutte & Koerting Company
Valves ..... Chapman Valve Mfg. Co.
Consolidated Ashcroft Hancock Co.
Pressure-reducing valve, venturi type ..... Schutte & Koerting Co.
Traps ..... Armstrong Machine Works
Piping ..... Grinnell Company
Crane, 10-ton, 38-ft. span, Shepherd Niles Crane & Hoist Corp.
Oil filters, two ..... S. F. Bowser & Co., Inc.
Oil coolers, two ..... Andale Company
Motor-generator set, 17.5 kw. Westinghouse Elec. & Mfg. Co.
Spray pond nozzles, 126, flat type ..... Schutte & Koerting Company
Sand filter and coagulation basin, 3,000,000 gal. per day ..... Roberts Filter Mfg. Co.

Instruments

Flow meters ..... Brown Instrument Company
Recording thermometers .... Brown Instrument Company
Recording pressure gages .... Brown Instrument Company
CO_2 machine, Ranarex ..... Permutit Company
Draft gages ..... Ellison Draft Gage Company
Water meter ..... Neptune Meter Company



ONE OF THE NEWEST PAPER MILLS *to go into operation is that of the John H. Heald Paper Company, at Lynchburg, Va., where a special process is being used, leading to what is practically a new creation in paper production. High-pressure boilers, pulverized-coal equipment, as well as bleeder and back-pressure turbines, have been installed in the power house.*

NEW HEALD PAPER MILL

Combines

Power and Process

THE power plant of the new John H. Heald Paper Company's plant at Lynchburg, Va., is located in the center of the mill, but with the usual fire walls and doors for protection against fires. Coal is received in gondola cars and dumped into a 30-ton track hopper above the crusher. Leaving the crusher it is lifted by a bucket elevator to the top of the building, where it is discharged into a screw conveyor that deposits it in 280-ton steel bunkers. It is thought that the maintenance of the screw conveyor, considering its relative short length, will be less than that of a belt conveyor.

From the bins the coal drops through automatic scales to three five-ton unit pulverizer mills on the ground floor, each in front of its own boiler.

After being ground, the coal goes into the exhauster blower, which forces the mixture of powdered coal and hot primary air into the Y duct leading to the two burners on each boiler. There is no means of connecting a pulverizer and exhauster of one boiler to a second boiler, and to insure against breakdown boilers Nos. 1 and 3 are provided with two mechanical-atomizer oil burners placed below the pulverized-coal burners. This is a cheaper arrangement than the cross connection of pulverizers, since with the latter there would necessarily be required cross-connection of the air ducts from the air heaters. The burners use natural draft and are hinged to swing out when not in use, with the openings closed by hinged plugs.

A cross sectional view of one boiler is shown on the next page. This is not materially different from the usual setting for this design of boiler, with the exception of the oil burners. Both the induced-draft and forced-draft fans are above the bunkers, there being one each for each boiler. The induced-draft fan pulls the flue gas through the vertical tubular air heater and discharges it through a 50-ft. steel stack. This type of stack was preferred to the single brick stack customarily used by reason of its first cost and the better chimney effect produced by individual stacks when only two of the boilers are under fire than is obtainable from a large stack serving three boilers.

Firing conditions are under automatic control, the mechanism regulating the speed of the turbines driving the exhausters through throttle valves in the steam lines above the turbine throttler valves. Each boiler is equipped with steam flow-air flow meters.

In deciding upon a steam power set-up for a mill in the paper industry there are no fixed rules for standardi-

zation of the various problems involved, and the quantity and type of pulp and paper to be manufactured have a major bearing upon the selection of equipment and the steam pressures to be used.

The boilers are designed for 325 lb., this being needed when the second section of the paper mill is constructed. This pressure was chosen to give the best heat balance, with a turbine bleeder pressure of 30 lb. gage.

As will be seen from the drawing, the two coal burners enter the front wall of the boiler along with the secondary air, which enters the air box around each burner through a sheet-iron duct connecting with the bottom of the air heater.

To prevent slag formation on the lower portions of the furnace wall smooth bare metal blocks are placed on the lower part of the side walls and on the uptake and downtake hopper floor. Rough metal blocks cover the upper portion of the side walls and the vertical portion of the uptake wall.

The slag drops into an ash hopper, where it is quenched and broken up by water sprays and then is carried by a water stream to an outside pit. The fly ash from the gas passages in the air heater is dropped through a cast-iron duct into the water trough as shown. Water for this purpose is supplied by a 1,500-g.p.m. motor-driven centrifugal pump located in the screen house outside the power house.

In the design of the plant the estimated boiler performance as shown in the tabulation was used.

TABULATION OF THE ESTIMATED BOILER PERFORMANCE

Steam flow per hour, lb	70,000	90,000
Steam pressure, lb. gage	325	325
Superheat, deg. F	100	104
CO_2, per cent	15	15
Gas temperature leaving boiler, deg. F	615	690
Gas temperature leaving air heater, deg. F	347	394
Air temperature to heater, deg. F	80	80
Air temperature from heater, deg. F	435	472
Feed water temperature, deg. F	200	200
Draft loss in boiler, in.	0.8	1.5
Draft loss in air heater, in.	0.88	1.5
Air resistance through heater, in.	0.60	1.0
Gas per hour, lb.	90,600	118,500
Air per hour, lb.	71,900	94,100
Efficiency, including boiler, furnace, heater and superheater, per cent	79.5	77.5

These computations were based on New River coal having the following characteristics: Moisture, 2.10 per cent; volatile, 20.12 per cent; fixed carbon, 74 per cent; ash, 4.78 per cent; sulphur, 0.76 per cent; and with a heat content of 14,900 B.t.u.

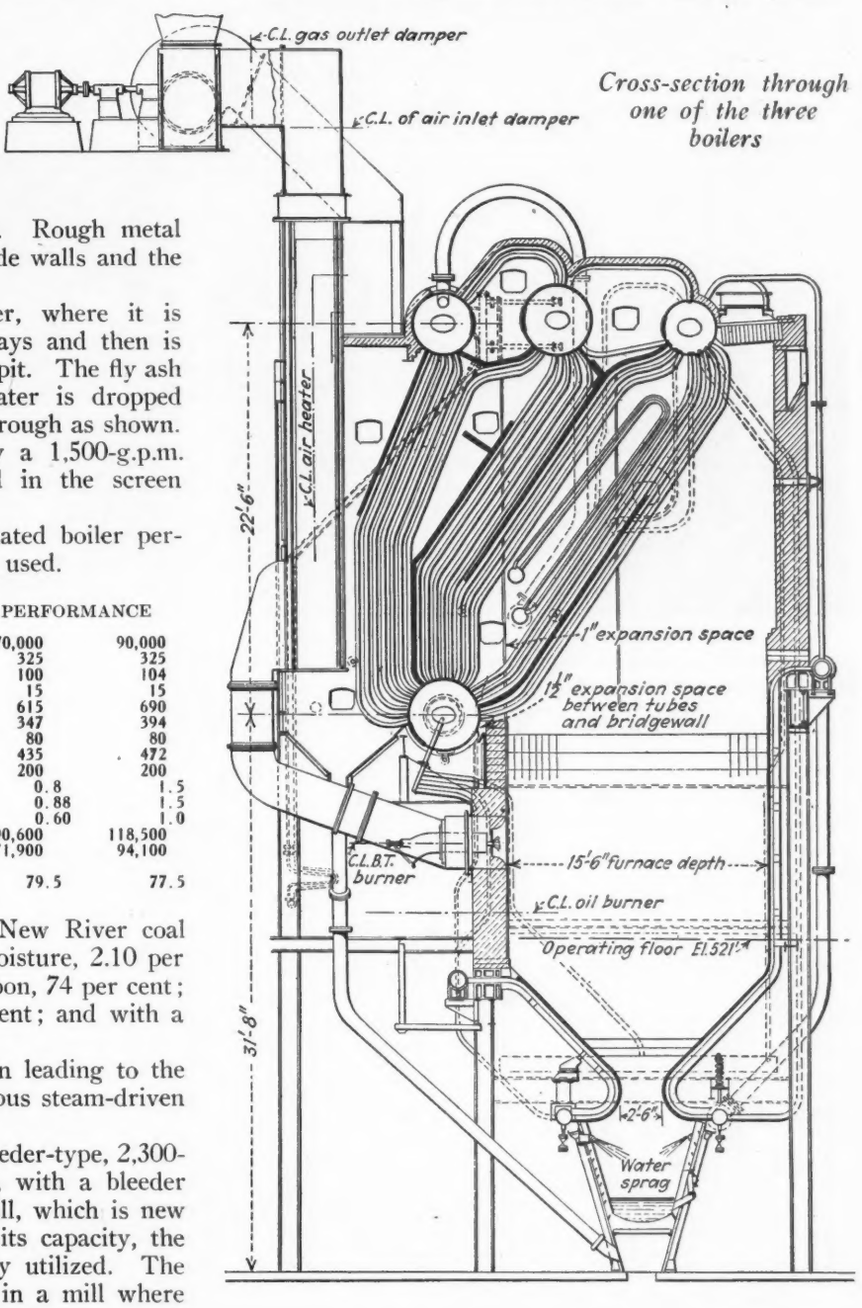
Steam from the boilers enters a main leading to the turbine room, with branches to the various steam-driven auxiliaries.

In the turbine room is a 4,375-kva. bleeder-type, 2,300-volt 3-phase 60-cycle turbine-generator, with a bleeder pressure of 30 lb. gage. When this mill, which is new and just starting production, is up to its capacity, the full size of turbine will be comfortably utilized. The load at present is only 2,700 kw., but in a mill where a new product is being made it sometimes is a month or more before full production is obtained, and when it is attained at this plant, the rating of the turbine will be used. The condition of small demand, due to present operation, also exists in the steam set-up, but the heat and power plans for full production utilize this equipment properly as chosen. Records taken from the plant in a month or six weeks from the present date probably will bear out this fact.

It was felt that the single turbine would work out better than two machines of an equal total capacity. Breakdown service, for at least part of the plant, is provided by a 500-kw. house turbine set, which when the addition to the paper mill is made, will be run continuously. This turbine exhausts into the 30-lb. steam main.

As the paper machine speed must be capable of micrometer adjustment, a 200-kw. motor-generator set supplies 250-volt direct current to the paper machine motors. For excitation there is a 75-kw. motor-generator set and a 75-kw. turbine-driven direct current generator.

The condenser for the main turbine is on the ground floor, below the turbine, and is provided with a motor-driven condensate pump. Condensing water is obtained from the James River through an intake house and centrifugal pump about one-half mile above the mill. The water, which carries much clay in suspension, is put through the condenser and then discharged into a concrete tank in a screen house. From this point motor-driven centrifugal pumps lift it to a vertical steel filter tank for the removal of the silt by gravity; the water is then used in the paper mill and for the boiler make-up.



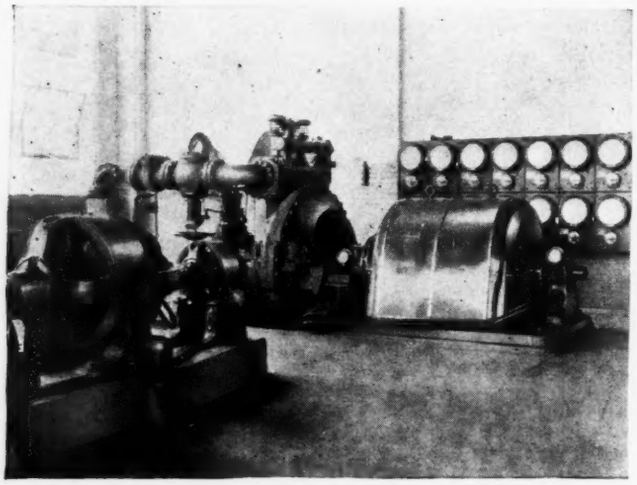
As the river water causes too much foreign matter to be used directly as boiler feed, a hot-process water-treating plant has been installed adjacent to the boilers. Water from the steel filter tank is forced to the treatment apparatus by a centrifugal pump in the screen house. After treatment the water is lifted to a storage tank located above the open heater, which is in one corner of the boiler house and elevated to a level with the turbine room floor. From the receivers two turbine-driven centrifugal pumps handle the water to the boilers. These turbines, as those on the pulverized-coal exhausters and the turbine driving the exciter, exhaust at 5 lb. back pressure into the open heater.

It will be noticed that many of the auxiliaries are turbine driven, this being done to provide the best possible heat balance. The turbine-driven boiler feed pumps would not give enough heat in view of the large per cent of make-up to be heated from about 80 deg. F.

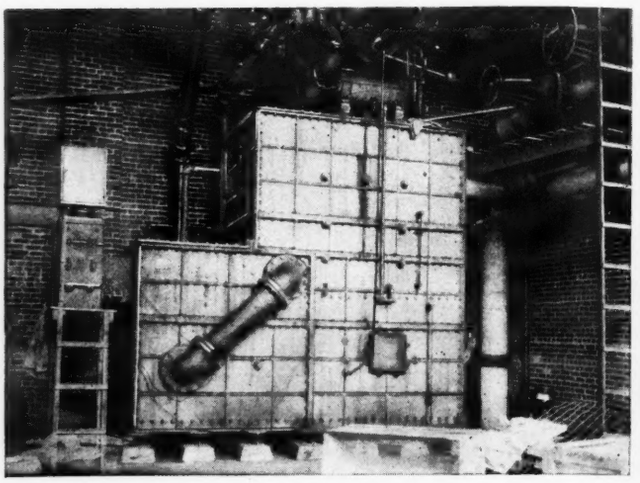
Complete record is kept of the steam used in the various departments. In the turbine room the instrument board contains fifteen recording meters showing steam going to all departments, including that to the tanning mill. As far as possible, all steam used in the digesters and other machines will be taken from the 30-lb. line,

The plant was designed and built by the Management Engineering & Development Company, Dayton, Ohio.

The house turbine and instrument board



Feed-water heater and receiver



Principal New Equipment Used at the Heald Paper Company

Boiler House

Boilers, three, 10,440 sq.ft., Class XXIV, No. 26, No. 8 tubes, with 4 gas passages. ..... Babcock & Wilcox Co.
Superheaters, three, B. & W. double-loop, single-pass, 10.25 in. I. D. headers, 35 outer loops, 34 inner loops, 1,248 sq.ft., 1-1-16-in. ferrules, (ultimate superheater to have three loops of 51 tube each, 2,296 sq.ft.) Babcock & Wilcox Co.
Air heaters, three, 11,900 sq.ft., straight-tubular type, 24 rows of 29 3½-in. No. 11 gage, 26-ft. tubes. ..... Babcock & Wilcox Co.
Pulverized-coal burners, 2 per boiler, Bailey-Tenny turbulent forced-draft type.... Fuller-Lehigh Co.
Mills, 3, Fuller-Bonnot ball type air separation ..... Fuller-Lehigh Co.
Drive motors ..... Westinghouse Elec. & Mfg. Co.
Reducing gear ..... Cleveland Worm Gear Co.
Exhausters, 3, driven by ..... Fuller-Lehigh Co.
40-hp., 1,200-r.p.m. ..... Terry turbines
Oil lighter, portable oil burner, including tank, hose and two atomizers. .... Babcock & Wilcox Co.
Oil burners, two each, on two boilers, San Diego natural-draft type..... Babcock & Wilcox Co.
Forced-draft, fans, three, No. 90, design 5, turbovane type ..... B. F. Sturtevant Co.
Induced-draft fans, three, No. 10, design 3, multivane, capacity 150,000-lb. per hr., 59,000-c.f.m.; 680-r.p.m., direct-connected to variable-speed motor ..... B. F. Sturtevant Co.
Water columns, B. & W. type W. S., with Sesure inclined gages and B. & W. cocks ..... Babcock & Wilcox Co.
Blow-off Valves—On boilers..... Babcock & Wilcox Co.
On superheaters ..... Yarnall-Waring Co.
Safety valves, two on drums set at 325 lb., and one on superheater set at 310 lb. ..... Consolidated Ashcroft Hancock Co.
Ash hopper, hydro-jet type, complete with hand-operated gates, quenchers, steel work and clinker chambers ..... Allen-Sherman Hoff Co.
Stacks, three stub-steel type, 50 ft. x 60 in. ..... Babcock & Wilcox Co.
Soot blowers for gas passages and gas intake to air heater..... Diamond Power Specialty Corp.
Boiler control, full automatic, controlling air and coal volumes ..... Bailey Meter Co.
Coal scales, one for each pulverizer, automatic ..... Richardson Scale Co.
Coal handling, bucket elevators and screw conveyors ..... Jeffrey Mfg. Co.
Heater, open cast-iron receiver type, with V-notch meter ..... Cochrane Corp.
Water-treatment system, hot-process..... Cochrane Corp.
Boiler feed pumps, two, four-stage Cameron centrifugal, direct-connected to 220-hp., 3,280-r.p.m. Terry turbines..... Ingersoll Rand Co.
Boiler feed makeup pump, one, 225-g.p.m., 1,750-r.p.m., 70-ft. head centrifugal, direct-connected to Westinghouse motor.. Goulds Pumps, Inc.

Generating Equipment

Turbine, one 4,375-kw. bleeder type.... General Elec. Co.
Condenser, one, 4,000-sq.ft., 1,273⅜-in. Muntz metal tubes, 16 ft. long, No. 18 B.W.G. for bleeder ..... Westinghouse Elec. & Mfg. Co.
Condensate pump, centrifugal type, 65,000-lb. per hour capacity, 90 ft. head, direct-connected to Westinghouse motor.. Westinghouse Elec. & Mfg. Co.
Air pump, Leblanc ejector type, capacity 46.5 lb. per hour at 28-in. vacuum, 70 sq.ft. of condenser surface..... Westinghouse Elec. & Mfg. Co.
Circulating water pumps, one, 5,000-g.p.m. centrifugal direct-connected to Westinghouse motors ..... Goulds Pumps, Inc.
Motor-generator set, one, 200-kw., 250-volt, 1,160-r.p.m. unit..... Westinghouse Elec. & Mfg. Co.
Exciter sets, one, 2,200-volt, 1,150-r.p.m. 120-hp. induction motor direect-connected to 75-kw. 125-volt generator..... General Elec. Co.
One 75-kw. 125-volt generator direct-connected to 3,600-r.p.m. G.E. turbine for stand-by ..... General Electric Co.
House turbine, one, 550-kw., 3,600-r.p.m., 2,300-volt unit, exhaust at 30-lb. gage.. General Elec. Co.
Switchboard, a 20-panel slate board and instruments ..... Westinghouse Elec. & Mfg. Co.
Meter board, slate board, with 15 flow meters to measure steam to all mills departments ..... Bailey Meter Co.
Atmospheric relief valves, multi-type..... Cochrane Co.
Valves..... Crane Co. and Chapman Valve Mfg. Co.
Piping ..... Crane Co.
Pipe covering ..... Philip Carey Co.

Evaporators *in New Application*

Generate Process Steam

An important new movement in the field of process-steam engineering has made great progress in the past year. Evaporators are now being installed to take a large percentage of the entire boiler output, return distilled condensate to the feed lines and deliver pure vapor to process. The great possibilities of this development are enlarged by the increasing availability of high-pressure boilers and prime movers

THE USE of evaporators to supply small percentages of distilled make up in condensing plants is a familiar and established practice. It is not generally known, however, that evaporators can be used to generate process steam from raw water and thus make possible the operation of boilers on pure distilled water in plants where most of the condensed process steam is never returned to the boiler house; or can give out oil-free process steam in plants using reciprocating engines.

This application of evaporators is not a mere theory. Large installations of this type have been going on for four or five years, and several are now in successful operation. Practically nothing has been said about these installations, and the important new possibilities thereby opened up in the field of process-steam engineering are still unknown to most engineers.

This development is of particular interest just now when high steam pressures are coming into general use, because such pressures provide ample margin for the generation of byproduct power by means of engines or turbines operated by the steam passing to the evaporator, or, in some cases, by the process steam produced by the evaporator. The evaporator, in turn, will make it practicable to operate the high-pressure boiler at high ratings in plants where the low percentage of returns from process and the poor quality of the raw make up would normally make it difficult to operate high-pressure boilers in the usual way even at low ratings.

The use of high-pressure steam makes it possible to operate the evaporator with a large temperature drop, thereby keeping the size and first cost of the evaporator within economical limits.

Many types of evaporators are used in connection with power installations, the most common consisting of coils or banks of tubes immersed in raw water or arranged to be covered with a film of raw water. Steam within the tubes evaporates the water, leaving behind the scale and sludge. The evaporators are blown down continuously, or at intervals, to remove the sludge and keep the concentration of the water within such limits that the vapor produced will not be contaminated by priming and foaming.

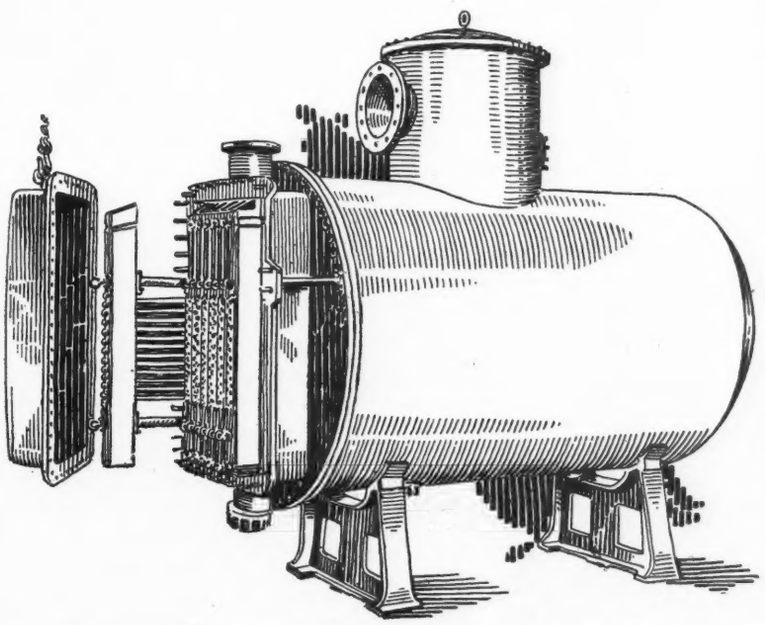


Fig. 1—A Griscom-Russell "reducing-valve" evaporator

Many evaporators have transfer surface of such curvature that abrupt temperature changes, known as scale cracking, will shed the scale from the transfer surface. Others have straight-tube transfer surfaces and are usually supplied with treated feed water.

The units shown in Figs. 1 and 2 are single-"effect" evaporators. Under average conditions an evaporator of this type will produce about 0.7 lb. of vapor for each pound of steam condensed in the tubes, the actual ratio varying with the pressures of the steam and the vapor and the temperature of the raw water fed to the evaporator. Where the single-effect evaporator is used in the ordinary way for boiler make up, the

condensate from the coils balances the steam supplied, so that the weight of vapor produced, later condensed by feed water or in some other way, is net make up.

Before discussing their new application it will be well to review briefly the ordinary use of evaporators to produce small percentages of make up in condensing power plants. Normally the feed water is used to condense the vapor, thus returning to the boiler practically all the difference between the heat supplied to the evaporator and that returned in the coil condensate. Except for radiation and blowdown there is no heat loss in the process. There is, of course, some loss in "heat head" or availability for power generation, because of the necessary temperature difference between the steam and the vapor.

For economical operation it is essential that the vapor be condensed by the feed water, without causing the waste of other steam, such as the exhaust of steam-operated auxiliaries, available for the same purpose. If this available steam is sufficient to heat the feed water to 212 deg. F., the steam to the evaporator must be supplied at a pressure high enough that the vapor can be condensed by raising the feed temperature as far as necessary above 212 deg. This "hook up" constitutes what is known as "high-heat-level" operation.

"Low-heat-level" operation means that the vapor is condensed by the feed water in some temperature range below 212 deg. It is frequently practicable where most of the auxiliaries are electrically driven. In stations where the turbines operate on the regenerative cycle, that is, progressively heating the feed water by steam bled from several stages of the turbine, the evaporator is usually arranged interstage. This means that it takes its heating steam from one extraction point and condenses its vapor in a condenser interposed between the evaporator heating stage and the next lower bleeding point.

Where the amount of make-up vapor required cannot be condensed by the feed water in the available unused temperature range of the feed water, it is necessary to resort to multiple-effect evaporators. In these, two or more single-effect units are connected in series, the vapor produced in the first effect condenses within the coils of the second effect to produce additional vapor, which passes to the coils of the next effect, and so on. The sum of the weights of vapor produced in all effects is thus available as make up, but only that portion produced in the last effect need be condensed by the heating of feed water. This portion is approximately half the make up with a double-effect evaporator, and approximately a third with a triple-effect.

All this discussion, it should be remembered, applies to the ordinary use of evaporators for boiler make up, as contrasted with the high percentage make ups of industrial plants. An understanding of this use will make clear the reason why evaporators used to supply process steam are apt to be single-effect. The function of the evaporator in the first case is to produce distilled water, while in the second it is to produce steam to be used in the vapor state. By adding effects, more and more distilled water can be produced from one pound of steam, but adding effects does not, on the other hand, increase the amount of available vapor at the outlet of the final effect. Rather it decreases it slightly. The vapor in each effect must condense to produce the vapor of the next. Only the vapor from the last effect is available for the outside use, and at a relatively low pressure.

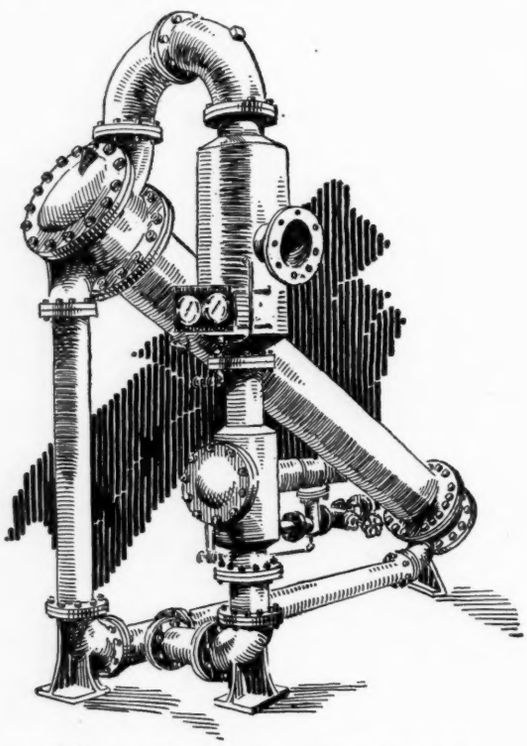


Fig. 2—Single-effect Struthers-Wells evaporator

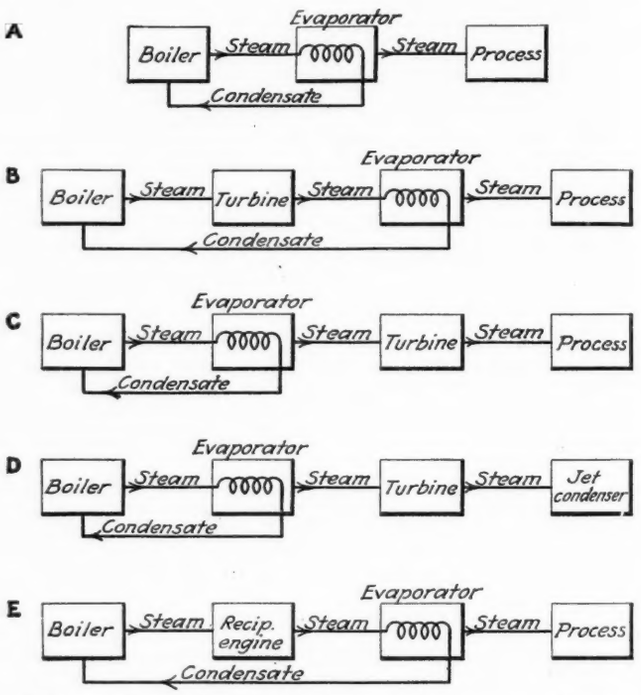


Fig. 3—Evaporator arrangements in process plants

So far, in this application of evaporators, four general arrangements have been used. These are shown diagrammatically in Fig. 3. In the first and simplest arrangement—*A*—steam passes directly to the evaporators, and vapor from the evaporator passes directly to the process main. The full weight of steam supplied to the evaporator returns as condensate to the boiler, which, therefore, operates continuously on distilled water.

From a heat-economy point of view this is practically equivalent to direct supply of steam to process. Mechanically, it shifts the burden of impurity removal from the boiler to an apparatus that cannot be injured by dirt. Furthermore, the handling of the bad water by an evap-

orator is of interest in that the heating is done by steam rather than by gases at 1,500 degrees.

Considering the over-all efficiency of a boiler sending steam through a reducing valve for use in process, and a similar requirement where the reducing valve is replaced by an evaporator, the amount of fuel burned in the boiler will be exactly the same in both cases, barring discussions of radiation and blowdown. Furthermore, it might be considered that the blowdown from an evaporator is no more than the blowdown that would have to be undertaken from a boiler where no evaporator is in operation.

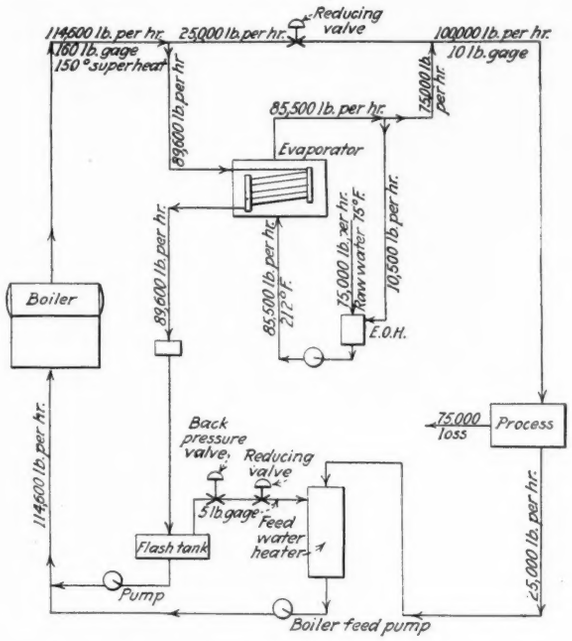


Fig. 4—Heat balance with reducing valve evaporator

The arrangement shown at *A* solves the feed-water problem but fails to utilize the byproduct power that the steam might produce. It is evident that the use of 200-lb. pressure drop in the evaporator leaves no reduction available for power generation.

The recent advent of practicable high-pressure boilers solves this difficulty. It is now a simple matter to raise the boiler pressure sufficiently to provide ample pressure range, or, more fundamentally, ample temperature range, for a prime mover and evaporator in series. The turbine or engine may come ahead of the evaporator, as shown at *B*, or after it, as shown at *C*. Both arrangements have been used. In general it is preferable to place the turbine ahead of the evaporator, in order to supply the turbine with superheated steam from the boiler and the process with saturated steam from the evaporator. Except for this element of superheat the two arrangements do not differ greatly in desirability or first cost.

All things considered, the turbine would be placed ahead of the evaporator unless there were some special reason for the reverse arrangement.

In some cases it will pay to install two prime movers, one ahead of the evaporator and one after it. For example, a central station or a district-heating plant might drop the steam pressure through a turbine from 1,200 lb. to 400 lb. It could then be reduced through an evaporator to 200 lb. for economical long-distance transmission. The customer receiving the steam at 150 lb., say, could pick up some additional power in a turbine exhausting to heating or process at 50 pounds.

Another arrangement already in actual use is shown in Fig. 3 at *D*. There the "reducing valve" evaporator makes it possible to operate a straight power station with a jet condenser employing condensing water unsuitable for boiler feed.

Another possible application is shown at *E*: Oil in the exhaust has been a serious drawback to the generation of byproduct power in reciprocating engines, where the steam must later come in direct contact with products that might be contaminated, such as foodstuffs and textiles. The arrangement shown puts the reciprocating engine on the same plane as the turbine in this respect.

While the higher boiler pressures permit, with a stated process pressure, the use of an evaporator of smaller dimension, high boiler pressures are not necessary in many installations when the savings through using an engine's exhaust steam would pay for a large capital investment in an evaporator.

The decrease, however, in evaporator size is not proportional to the increase in boiler pressure, but depends upon the temperature difference between the steam going to and from the evaporator. For example, if steam at 400 lb. is passed into the evaporator, its saturated temperature is 445 deg. F. If the evaporator delivers steam at 200 lb., its temperature will be 388 deg. F., a temperature difference of but 57 degrees.

If, in a process plant, steam is needed at, say, 30 lb. and the boiler pressure is 200 lb., then to obtain the same temperature drop in the evaporator as with the 400-200 lb. combination the evaporator entrance pressure must be 90 lb. gage. It is possible then to expand from 200 to 90 lb. in the generating unit before the steam reaches the evaporator. But if the evaporator surface were doubled, and if the process could use 20 lb. instead of 30 lb., the doubled surface would permit the steam to be expanded to 40 lb. gage in the engine, greatly increasing the power obtained from a given steam flow from the boiler.

Even where a compound engine is operating condensing and the processes are being supplied with boiler steam, it may be profitable to bleed steam from the receiver for evaporating use or even to run the engine non-condensing, exhausting into the evaporator.

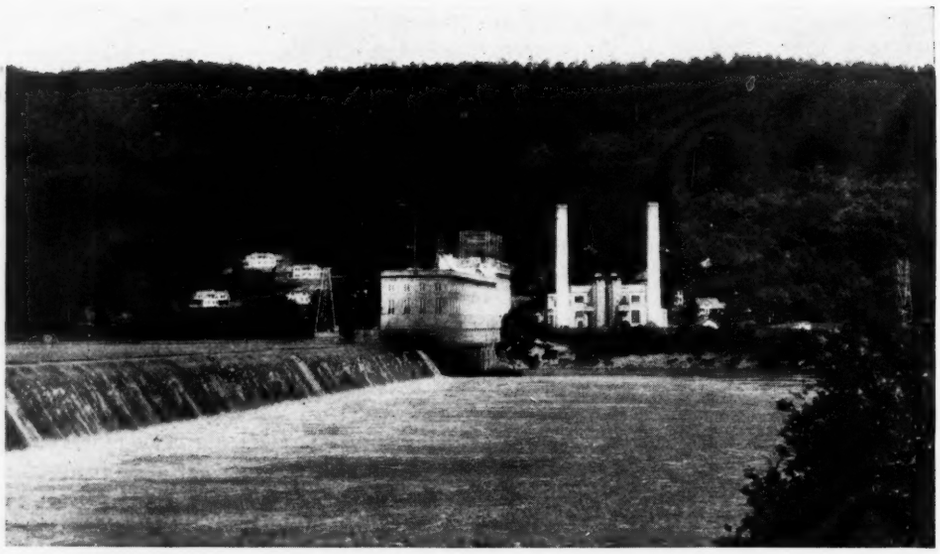
Passage through the ordinary reducing valve increases the superheat of steam. For some processes this necessitates the installation of a desuperheater. In such cases the evaporator replaces both the reducing valve and the desuperheater.

If, however, it transpires that the evaporator must be installed in a position remote from the process plant, it is a simple matter to introduce a steam reheater whereby the evaporator vapor is given superheat by a fraction of the heat content of the steam entering the evaporator heating chamber.

An actual hook up of an evaporator is, of course, not as simple as might appear from the diagrams shown in Fig. 3. A complete diagrammatic layout corresponding to Fig. 3 *A*, but with return of 25 per cent of the process condensate, is shown in Fig. 4.

This diagram gives actual weights, temperatures and pressures for an assumed case and shows the method of "flashing" the evaporator condensate.

Power is indebted to Stanley Brown, head of the utilities department of the Griscom-Russell company, for considerable information on the evaporator, art which has been embodied in this article.



Hales Bar hydro-electric plant has an installed capacity of 54,240 hp., and the steam plant 53,620 horsepower

Power Development in the Tennessee Basin

By J. A. Switzer
Consulting Engineer
Knoxville, Tennessee

The Tennesee River *and its tributaries is one of the largest sources of water power in this country. The author draws the conclusion that the development of this power will greatly stimulate the demands for coal to supply heat, process steam and other services to new industries that will be attracted to that district by the hydro-electric power.*

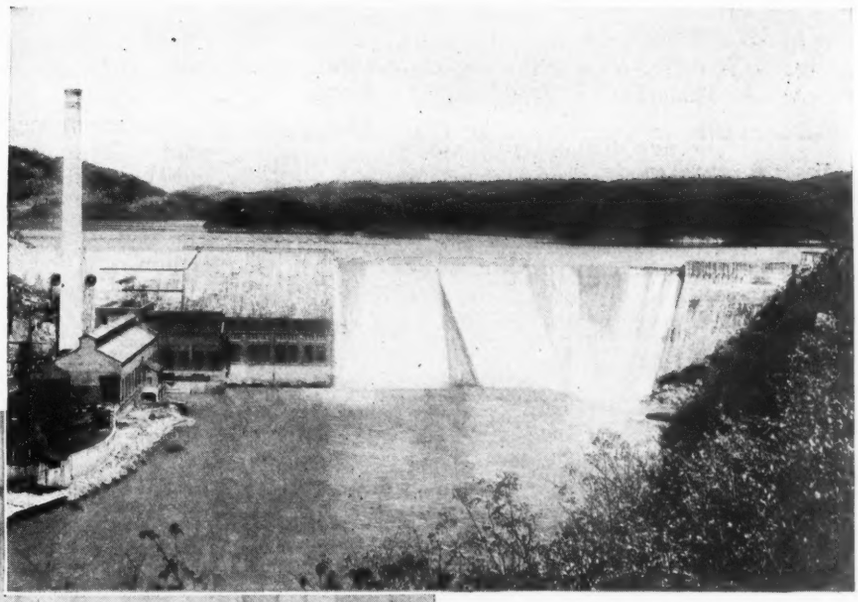
THE Tennessee River Basin is more richly endowed with potential water power than any equal area in eastern United States. This territory is at the beginning of an industrial expansion, growing around water power, that is fast converting it into an important manufacturing center. The importance of the Tennessee River for water power, navigation and flood control is such that a survey of the territory has been made under direct appropriations of Congress. This survey, made at a cost exceeding $1,000,000, was begun under Major H. C. Fiske and completed under Major L. H. Watkins, of the U. S. Corps of Engineers.

No such thorough-going survey of an entire river system has ever before been made. It indicates the possible utilization of about 140 water power projects. A number of these will be for power and navigation, and others will be storage developments. As a result of the survey it has been possible to work out a plan of co-ordinated developments in accord with the highest principles of conservation. The three-fold end of making available an enormous amount of power; of improving navigation to the point where, for the first time, the Tennesee River will be really navigable; and of very considerably mitigating devastating floods will be served. It is estimated that an installed capacity of 4,777,800 kw. of hydro and 1,077,000 kw. of steam capacity will be required to completely develop the Tennessee River and its tributaries.

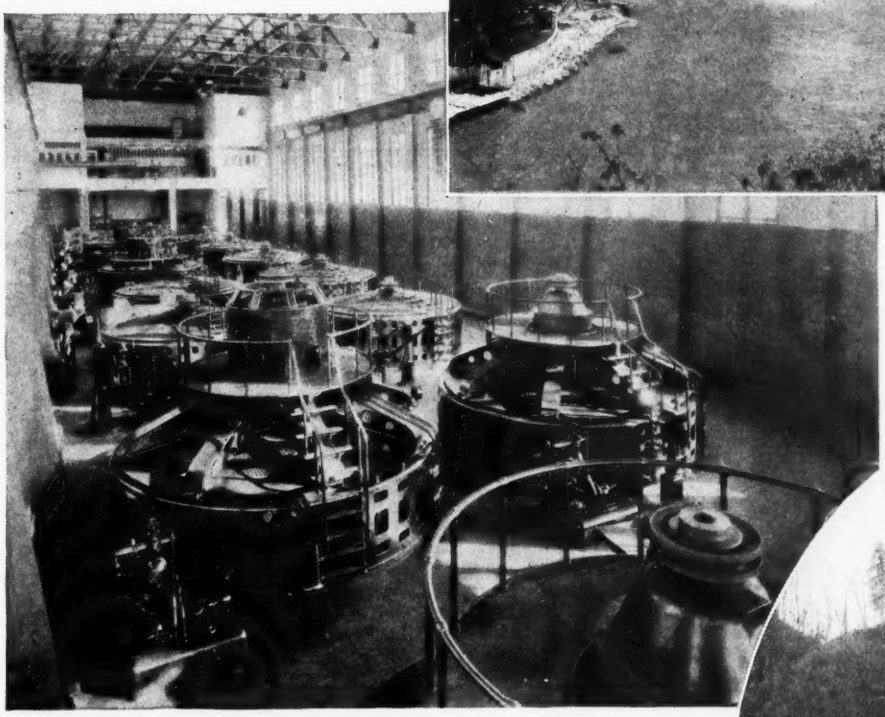
Power developments within the Tennessee River Basin now in operation or under construction make an aggregate installed generating capacity, including the steam auxiliary plants, of 1,250,000 hp. This figure includes 100,000 hp. developed by steam at Nashville and water power at Great Falls. Both of these are outside of the basin of the Tennessee River, but feed into the system, which lies for the most part within the basin. The present development constitutes only about one-fifth of the total potential power within the territory. During the year 1926 the amount of electric power actually consumed in this area was 1,100,000,000 kw-hr., and the government survey indicates the possible economic development of approximately 25,640,000,000 kw.-hr., or about 23 times the 1926 consumption. Of this amount, the steam auxiliary plants would produce about 12 per cent during an average year.

The Tennessee Electric Power Company is the largest public-utility power company in Tennessee. It operates

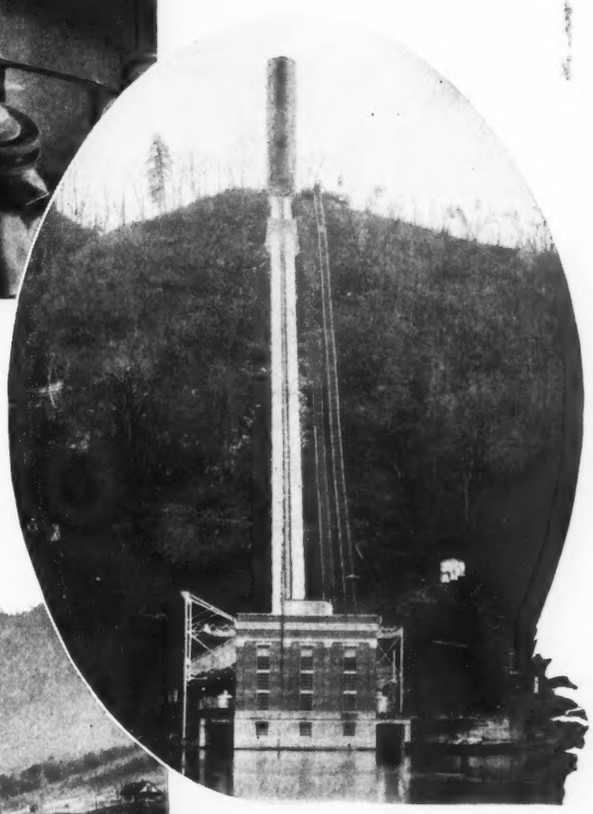
POWER PLANTS *in the* TENNESSEE BASIN



Right — Tennessee Electric Power Co.'s Ocoee No. 1 hydro plant at Parksville, Tenn., has 30,150-hp. and the steam plant 20,100-hp. capacity

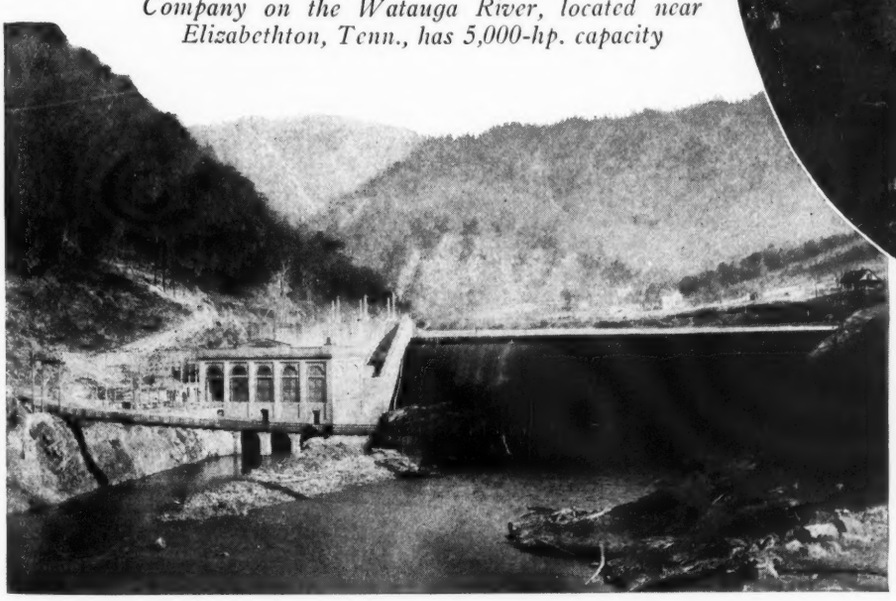


Above—Interior of the Hales Bar hydro plant, located 15 miles west of Chattanooga, which has 14 units and operates under a 38-ft. head



Above—Rymers Ferry hydro plant of the Aluminum Company of America has two 33,000-hp. units operating under a 660-ft. head. A 25,000-ft. tunnel and pipe line connect the power house to the dam on the Cheoah River

Below—Wilber hydro plant of the Cities Service Company on the Watauga River, located near Elizabethton, Tenn., has 5,000-hp. capacity



four hydro and three steam plants, and has a large storage reservoir under construction. The operating plants are given in Table I.

TABLE I—PLANTS OF THE TENNESSEE ELECTRIC POWER CO.

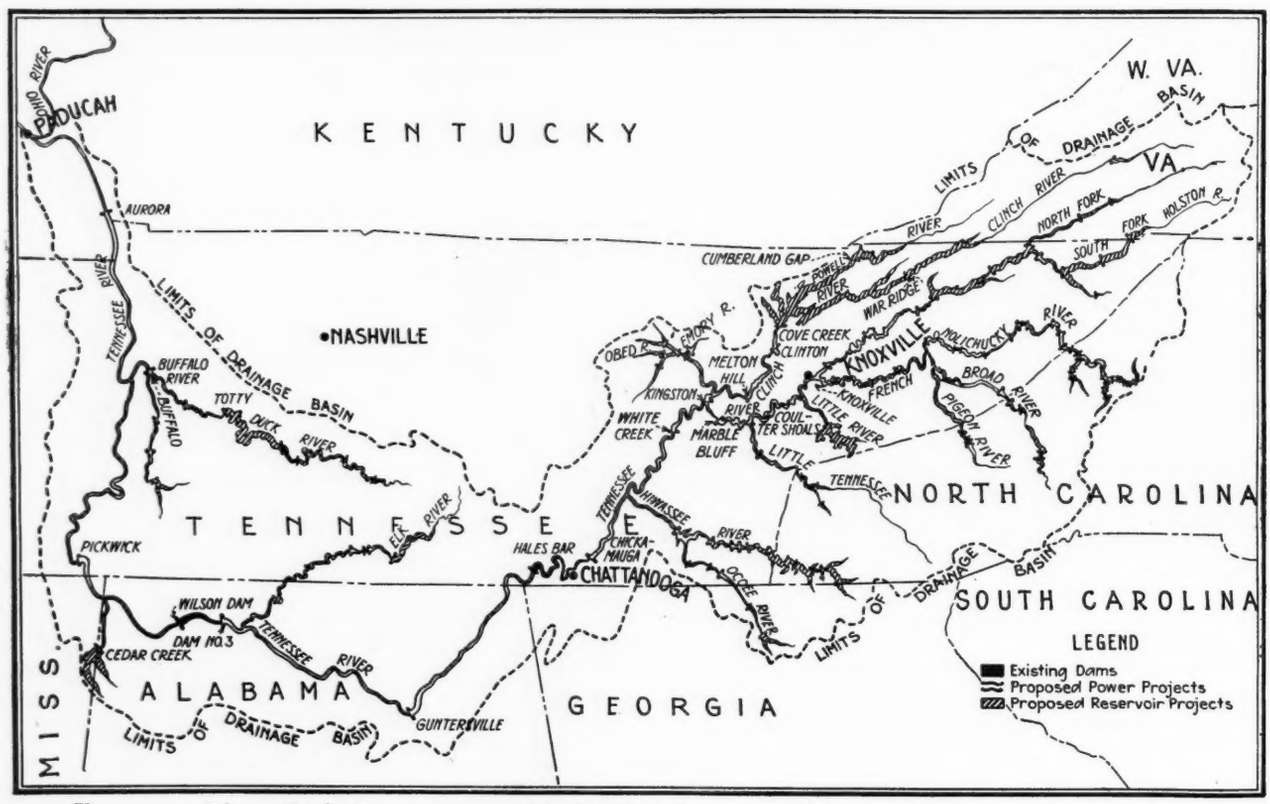
HYDRO-ELECTRIC PLANTS	
Hales Bar, installed capacity, hp	54,240
Great Falls, installed capacity, hp	35,510
Ocoee No. 1, installed capacity, hp	30,150
Ocoee No. 2, installed capacity, hp	24,120
Total installed capacity, hp	144,020
STEAM PLANTS	
Nashville, installed capacity, hp	64,330
Hales Bar, installed capacity, hp	53,620
Parksville, installed capacity, hp	20,100
Total installed capacity, hp	138,050
Both hydro and steam	282,070

Hales Bar plant is on the Tennessee River 15 miles west of Chattanooga, and the mean head is 38 ft. Construction was begun in 1905 and the plant was put in operation in 1913. The dam, including the lock, is 2,400 ft. long and in the power house there are 14 units.

The Great Falls plant is located on Caney Fork, a tributary of the Cumberland River, in middle Tennessee. The dam is 75 ft. high to the top of the tainter gates, and 94 ft. high to the highway bridge which surmounts the dam. Designed to accommodate a flood flow of 60,000 sec.-ft., the dam successfully handled 200,000 sec.-ft. a few months ago. The power house is located at some distance from the dam, water reaching the two turbines through short tunnels and penstocks to produce a head of about 160 ft. The plant was put in operation in 1916, but in 1925 the dam was increased from 40 to 75 ft. high.

Of the plants on the Ocoee River, that at Parksville, called Ocoee No. 1, was completed in 1912, and was the first large hydro-electric plant completed in Tennessee. The dam is 110 ft. high and creates a lake about eight miles long. Just above back water from the Parksville dam is the power house of Ocoee No. 2, with two units, completed in 1913 and operating under a 256-ft. head. This development has a timber flume 11 by 14 ft. and 4.7 miles long, in which about 8,000,000 board-feet of lumber was used. To prevent damage from overflow from the flume or the fore bay in case of a sudden drop in load, the fore bay is equipped with a large syphon spillway. The usefulness of the two Ocoee River plants will be increased by the reservoir, now building at Blueridge, Ga., which will have 230,000 acre-feet storage.

The Tennessee Electric Power Company owns and operates the street-car systems of Nashville and Chattanooga and has over 800 miles of high-voltage transmission lines and several hundred miles of distribution lines. Its system reaches 135 communities and about 95,000 customers. The company supplies power to the Knoxville Power & Light Company, and to a number of other distributing companies, the principal one of which is the Southern Cities Power Company. The power generation by the Tennessee Electric Power Company for the four past years has been as given in Table II. It is expected that the 1929 generation will exceed 800,000,000 kilowatt-hours.



Tennessee River Basin survey map showing location of existing and proposed hydro-electric plants and storage reservoirs

TABLE II—POWER GENERATED BY THE TENNESSEE ELECTRIC POWER COMPANY

Year	Hydro-Generation, Kw.-Hr.	Steam Generation, Kw.-Hr.	Total Power Generated, Kw.-Hr.
1925	427,305,770	221,593,548	648,899,318
1926	513,526,447	126,990,760	640,517,237
1927	525,761,321	119,085,197	644,846,518
1928	654,475,220	75,585,883	730,061,103

The Cities Service Company has recently acquired and is now consolidating a number of properties in upper East Tennessee. These include the Bristol Gas &

Electric Company, the Watauga Power Company and the Tennessee Eastern Electric Company. The principal generating stations, are hydro, on the Nolichucky River, of 16,000-hp .capacity, and 5,000 hp. on the Watauga River, and an 11,000-hp. steam station near Johnson City, Tenn. This company's territory is served by a 44,000-volt system, which is rapidly being extended. Special effort is being made to extend into rural sections.

The Carolina Power & Light Company, while serving a territory, and developing most of its power, to the east of the Tennessee River Basin, has recently acquired 8,000 hp. of hydro-electric plants on the French Broad River, near Asheville, N. C., and the Phoenix Utility Company is now building for it one of the outstanding hydro-electric plants of the country. Located on the Big Pigeon River, just east of the line between Tennessee and North Carolina, this plant will operate under a static head of 861 ft., and is described in the next issue.

The Knoxville Power & Light Company has a steam plant of 11,000 hp., that is held as a standby, the company finding it more desirable to purchase power. Affiliated with the Knoxville Power & Light Company is the Tennessee Public Service Company, which serves the territory just east of Knoxville. This organization furnishes power to a number of towns and one of the richest farming sections in Tennessee.

Two Outstanding Plants

Coming now to the developments of the Tallassee Power Company and the Knoxville Power Company, subsidiaries of the Aluminum Company of America: these plants, located on the Little Tennessee River and its tributary, the Cheoah, generate power for public service and for the aluminum company's plant and sheet mill at Alcoa, Tenn. The first hydro-electric plant built by the Tallassee Power Company is known as the Cheoah plant. The dam, 192 ft. high, is built across the Little Tennessee River, just above the mouth of the Cheoah River. Water is taken through a short tunnel and penstocks, to four turbines of 108,000-hp. capacity.

The second development begins with an arch dam, 190 ft. high, across the Cheoah River, at the mouth of Santeetlah Creek, several miles above the confluence of the Cheoah with the Little Tennessee. From the dam the water is carried for a distance of 25,000 ft. to the power house, located at Rymers Ferry. On the line of the conduit there are five tunnels, the longest one being 9,000 ft. Three of the tunnels are lined and carry water under pressure, but the steel pipe line is carried through two of the shorter tunnels. Some 800 ft. back from the power house the last tunnel terminates at a differential surge tank, and from this the penstocks run to the power house. The plant operates under a head of 660 ft. and has a capacity of 66,000 hp. in two units.

These two plants are in North Carolina, but below the Cheoah plant a third development is being built on the Little Tennessee River by the Knoxville Power Company. This plant, known as the Calderwood, is scheduled for completion next January and will have an installed capacity of 168,000 hp. ,The dam, 210 ft. high, is of arch design, having a thickness at the base of only 40.5 ft. Flood discharge over the dam will spring clear, and in order to guard against scouring of the bed rock, a cushion dam, 40 ft. high, will be constructed. With a maximum flood flow of 200,000 sec.-ft. over the crest, the cushion pool will be about 70 ft. deep, and the free fall will then be about 130 ft. From the dam a tunnel equivalent to a circle 26 ft. in diameter and 2,200 ft. long, cuts across a long loop in the river. The head on the plant will be approximately 210 ft. The installed capacity of the Tallassee and the Knoxville companies plants will be 342,000 hp.

The United States Government comes into the power picture of the Tennessee Basin by reason of the Muscle Shoals plant. Wilson Dam, planned as a war measure, was begun in 1918 and completed in 1926. This dam, with a height of 92 ft., has the distinction of being the largest monolithic structure in the world. Eight generating units, with a capacity of 260,000 hp., have been installed and foundations are in for ten additional units which when installed will bring the capacity of the plant to 610,000 horsepower.

The limits of this paper do not permit a description of the undeveloped power sites. The total amounts of power, including that already under development, capable of being utilized within the Basin is summarized from Major Watkin's report of the government's survey in Table III.

In certain quarters where a tender feeling is entertained for the coal-mining industry, the possibility of the development of such a huge amount of water power gives some little concern. There are those who go so far as to believe it a patriotic duty to discourage water-power development. The writer believes that these people are seeing ghosts where there are none. The normal development of water power within the territory will inevitably greatly stimulate the demand for coal.

In spite of the fact that in large modern steam plants power can be produced almost as cheaply as in hydro-electric plants, the latter have an undoubted lure for new industries. Many of these new industries will need process steam. All of them will increase the coal-consuming population, and here as elsewhere, it will be found that the more water power put to work turning the wheels of new industries, the better will be the market for coal.

Another phase of this question is that incidentally to the development of water power will come the improvement of the rivers for navigation, and none is more in line to profit by the consequent reduction of freight rates than the coal industry. The transportation by water

TABLE III—SUMMARY OF POWER PROJECTS, DEVELOPED AND POTENTIAL, IN THE TENNESSEE BASIN

River	[Number of Projects	Total Fall Utilized, Feet	Installed Capacity, Horsepower
Tennessee	11	522	3,546,900
Hiwassee	9	1,224	410,000
Ocoee	3	1,170	70,000
Holston	15	876	486,800
Nolichucky	43	1,756	256,420
French Broad	11	1,283	584,100
Big Pigeon	10	1,500	233,500
Little Tennessee	7	1,181	480,000
Duck	6	328	174,400
Elk	5	349	90,820
Clinch & Powell	7	936	443,710
Emory & Obed	7	758	95,400
Little River	2	596	32,000
Other streams	6	....	....

from the Northwest to Knoxville of 3,000,000 bushels of grain a year for trans-shipment to the Southeast, where now the grain goes by rail only and not through this territory, will bring benefits both direct and indirect to the coal industry of the section. This is but a single illustration.

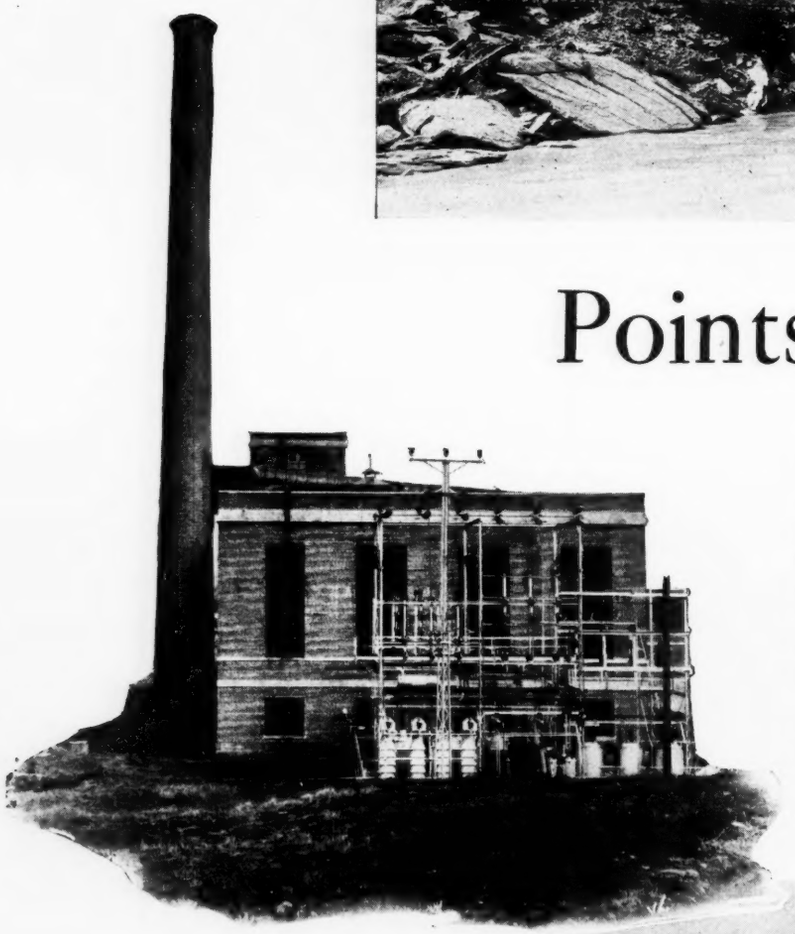
If the busy business man of the Tennessee Valley could look up long enough from his own knitting to catch a vision of what this vast pool of water power can be made to mean to him, he would tell his friend in politics that the political embargo on developing water power above Muscle Shoals has gone far enough.

Right—Ocoee No. 2 hydro plant of the Tennessee Electric Power Co., near Parksville, Tenn. This plant has an installed capacity of 24,100 hp. and operates under a 256-ft. head

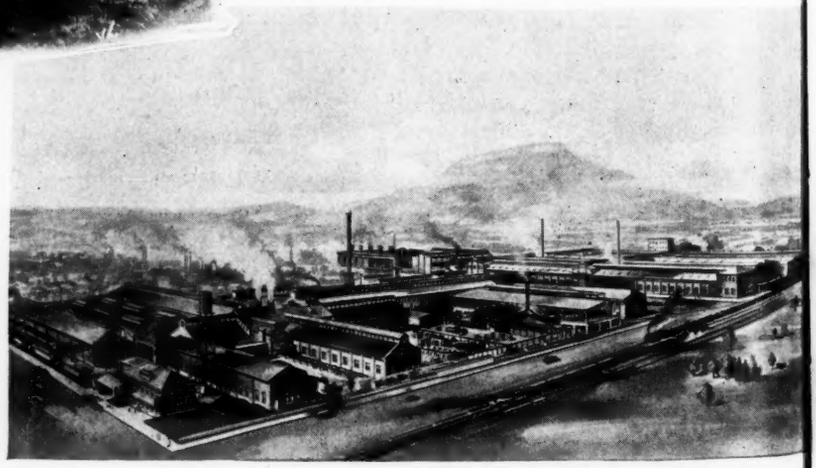
Points of Interest a N

CHATTANOOGA, TENN., where the National Association of Power Engineers will hold its annual convention on Sept. 9 to 13, has a gorgeous setting among the hills and mountains. It is surrounded by Lookout Mountain, Signal Mountain, Raccoon Mountain, Missionary Ridge, Walden's Ridge and other rises of the Cumberlands, so that the city is endowed with notable mountain scenery, spectacular cavern attractions and historic associations.

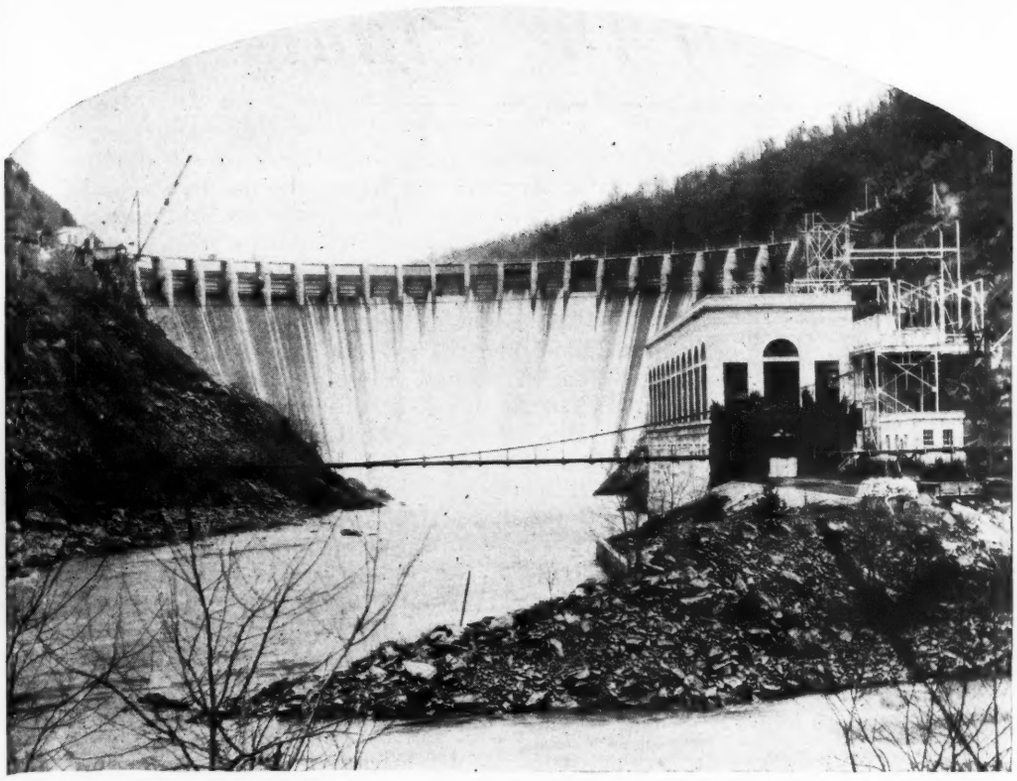
With 400 important manufacturing plants, making 1,500 different articles, the city is primarily industrial. Sawmills, boilers, sugar-making machinery, oil-well drilling equipment, fire hydrants, valves, bathtubs and enamelware,



Above—Cities Service Company 11,000-hp. steam plant on the Watauga River near Johnson City, Tenn.



Right—Combustion Engineering Corporation, Hedges-Walsh-Weidner No. 2 boiler manufacturing plant is scheduled on the convention program for a visit



Left—Hydro plant of the Tallassee Power Company on the Little Tennessee River in North Carolina. This plant is rated at 108,000 horsepower

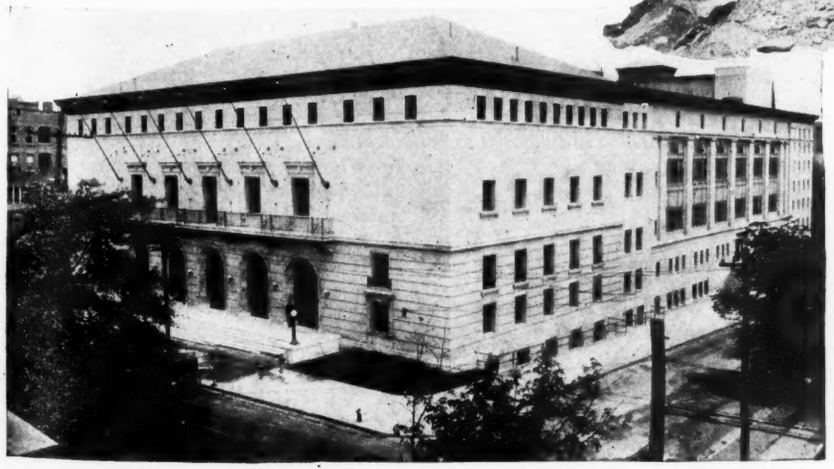
Below—Famous umbrella rock, Lookout Mountain, near Chattanooga

a N.A.P.E. Convention

dyeing machines and knitting machines are some of the many of its manufactured products.

The directory census for 1928 gives the city a population of 156,336. Employees in manufacturing plants number over 36,000. The value of the products manufactured annually approximates $165,000,000, and the export business last year aggregated over $6,000,000. The capital invested in Chattanooga's industries reached nearly $150,000,000.

In the accompanying illustrations are shown some of the attractions that may be easily reached from the convention city. A description of all the large power plants in the basin of the Tennessee River is on pages 338 to 341 of this issue.



The headquarters of the convention will be at the Hotel Patten but the meetings and power-equipment exhibition will be held in the Soldiers and Sailors Memorial Auditorium shown on the left. This auditorium has been called one of the three greatest structures of its kind in America

Right Out of the Plant

Getting Highest Efficiency From Inter-connected Systems

IT IS quite often that we find a power generating company with two or more plants in its system that do not have the same efficiency. The central generating station, with its modern machinery and close supervision, is usually more efficient than the smaller stations used as stand-by plants or for peak load only.

Let us suppose that the system has a periodic large demand for power and that the smaller station is called "on the line" to help carry this load on the system. Now, the capacity of a generating unit is usually rated on the temperature rise in the windings, an upper limit that allows a fair factor of safety being set. It is the current, of course, that causes the heating of the winding. This is true whether the current is wattless or useful.

With two or more plants generating in the same system, it is very easy for one of the stations to pick up the wattless current of the system, or most of it at least, and leave the other stations with a load at a high power factor. This is done simply by raising the voltage on the machine that is to pick up the wattless current. It seems to be an accepted fact that it requires very little extra power for generating the wattless current.

When the smaller and less efficient plant is called on to help with the load, instead of allowing it to pick up its share of the load with a power factor at, or near, the power factor of the larger plant, why not let the smaller plant pick up the most of the wattless current of the system and leave the larger station with a high power factor? This will reduce the current in the windings of the larger generators, thus reducing their temperatures. In this way the larger plant will be able to pick up more load from the system, thus reducing the load on the smaller station.

Thus the larger and more efficient plant carries a larger load than it would be able to carry without the aid of the smaller plant, while the smaller and less efficient plant is carrying a light load at a low power factor. This will give the bulk of load that would normally be carried by the smaller plants to the plant where it can be made at a much lower cost, resulting in an important saving for the system.

Beaumont, Texas — R. F. SORRELLS

Molds for Hydraulic Leathers

IN THE June 11 number of *Power*, is an article under the above heading by E. J. Jordan with which I do not fully agree in a number of places.

Mr. Jordan says that hydraulic leathers of factory make usually "have the hair side out, perhaps because of better appearance."

There may be manufacturers of hydraulic leathers who are more interested in appearance than in the making of a packing that will give maximum service. However, I know that there is at least one manufacturer who is not guided much by appearance and I dare say manufacturers of the highest grade leathers are influenced entirely by serviceability rather than by appearance.

Experience has demonstrated that for ordinary hydraulic work a high grade leather packing will perform as well with the grain side out as with the flesh side out. Therefore, they usually are made with the hair side out because they *do* look better when made that way, as stated by Mr. Jordan.

Small packings are molded more easily with the flesh side out. This is especially true of packings one inch in diameter and under. There are fewer rejections when molded flesh side out. Therefore, the manufacturer molds the smaller sizes in this way excepting where packings with the hair side out perform better.

For pneumatic packings, flesh side out gives better service and therefore is standard practice. The hair side is the tightest portion of the leather, and so the air pressure is against the side that is best able to hold it.

For operating valves and elevator valves, where the packings pass port holes and where the cylinder is in a somewhat worn condition, the packings also work better flesh side out, and it is the practice of one manufacturer to furnish packings this way.

Mr. Jordan brings out an important truth. A shallow packing is far more efficient and will last longer than a packing of greater depth. It is not possible to make a hard and fast rule on depth, as the correct depth depends on conditions in connection with the particular installation. However, it is true that a great many packings are ordered deeper than they should be.

What I object to principally in Mr. Jordan's article as its implication that hydraulic packings are easily made. That is not true. He tells and shows how to make the molds, which is all right in an emergency, but as a matter of standard practice I think it is poor economy to use homemade packings. I shall be so bold as to say that I am certain the packings produced by Mr. Jordan's mold are not nearly as well made as those put out by a first-class manufacturer.

I also maintain that it is impossible for any power plant engineer to make a packing as cheaply as it can be purchased.

I am curious to know what it cost to make the molds illustrated in the article. No doubt they are well made and no doubt are good, but they are antiquated as compared with the molds and other equipment used by a modern manufacturer.

There comes to my mind one engineer who replaced a leather packing every month. He thought he was using the best packing that he could get. Finally his attention was called to a packing that cost considerably more than the one he was using but was said to be a great deal better. He tried it out and was astonished to find that it lasted a year, whereas the others lasted only one month. The packings he replaced every month were factory made. Had he made them himself he probably would have been obliged to replace them twice a month or even oftener.

Simply because the making of a leather packing looks easy and because one can make a leather packing that works or that seems to work, does not prove that it pays to make one's own packings. I will go so far as to say that even if the average leather packing made by the average engineer costs nothing, it would still pay to buy the best factory made leather packings obtainable.

Newark, N. J. — W. F. SCHAPHORST

Selecting a Waste-Heat Boiler

IN LAYING out a waste-heat boiler plant for generating steam several factors enter into the matter. Much depends upon the source of the waste heat.

If the waste heat to be absorbed comes from a cement kiln, the fire tube boilers will give much less annoyance from fouling with fly cement than will water-tube boilers, for with the latter a great deal of annoyance has been experienced from the cement dust bridging across the tubes and closing up the gas passages. I have seen some new installations of 10,000 sq.ft. box-header horizontal water-tube boilers where it was necessary to blow the tubes every four hours in order to keep open the gas passages. By using a fire-tube boiler of suitable dimensions, this would have been a much simpler job.

In the case cited, superheated air was used to blow the tubes, this being done with a hand lance. The job required that two men on each of three eight-hour watches do nothing else but blow tubes on five four-pass horizontal water-tube boilers, which used waste heat from six rotary cement kilns. As time progressed trouble was experienced from the cement eroding away the stay-bolt heads in the box headers. This trouble was so extensive that refractory monolithic baffles were placed against the heads to protect them from the erosion of the cement.

This plant also had a two-pass economizer and a turbine-driven induced-draft fan, which required considerable replacement. Undoubtedly a fire-tube boiler of sufficient length and suitable diameter of tubes would have taken the place of both boiler and economizer and could have been served by a single soot blower, which arrangement would have eliminated the necessity of one man.

In another water-tube boiler plant much trouble was experienced through using gas ducts at a point just before the gas entered the first pass of the boiler, where the velocity was too high. This high velocity caused the cement dust to melt sufficiently to adhere to the walls, building up until the duct was practically closed.

Many of these annoying conditions could have been more easily eliminated with a fire-tube boiler. Flue-blowing would have been simplified and accomplished with one-half the labor cost, and the boiler setting could have been reduced in size. Better precipitation of the cement dust could have been accomplished before the gas entered the tubes.

Where the waste heat boilers are used in connection with illuminating-gas generators, two are installed and they are usually fire-tube boilers, at least the one through which the green gas passes. Considerable tar deposits on this boiler surface, which must be removed by turbining or boring. This would be utterly impossible if the gases were coming in contact with the exterior of any tube, as in water-tube boilers.

In gas house work, the shell-type fire-tube boiler offers an excellent opportunity to make gas-tight connections to the heating surface of the boiler. No brick setting is employed, and consequently the shell is not used as a heat absorber, which places the fire-tube boiler on a par with the water-tube boiler as far as long life and safety are concerned. The shell of a shell-type fire-tube boiler should last indefinitely.

In comparing the two types of boilers, the supposition is that either one will be supplied with practically scale-free water, for any one striving for economy to the extent of installing waste-heat boilers certainly would not overlook the important factor of supplying the boiler plant with suitable feed water.

In most installations the waste heat boiler does not receive its energy through the medium of radiant heat, and for this reason, the heat-absorbing arrangement is usually quite a different proposition from that of a boiler with a fuel-burning furnace.

S. C. PAGE.

Rochester, N. Y.

Why Use Low-Pressure Boilers In Large Office Buildings?

A RECENT article in *Power* describing the electrical installation in a large New York office building suggests some comment upon the policy which is now being generally followed in regard to the design of the engineering equipment of such buildings.

Some years ago it was customary, in office buildings of any size, to install high-pressure boilers, which supplied steam to operate generating sets, house and elevator pumps, etc., the exhaust from these units being utilized to heat the building.

Due to increasing demands for power, on account of the use of high-speed electric elevators, more elaborate ventilating equipment and the like, the exhaust steam from the generating sets usually exceeded the amount of steam required for heating the building, so that a considerable amount of steam was wasted to the atmosphere, except in severe winter weather.

Another difficulty frequently encountered with such installations was that the peak demands for electricity and heat did not coincide, the maximum heating load usually occurring in the early morning when the building was being warmed up, and the elevator and lighting load coming on later in the day when the building required a comparatively small amount of steam for heating purposes. These conditions, together with the decreasing cost of central station power and an aggressive sales campaign by the central station interests, have resulted in many recent buildings being equipped with heating boilers only, all electricity for power and lighting purposes being purchased.

The question now arises: Has not the swing towards the purchase of central station power for office and loft buildings been carried too far?

Take the typical installation which is to be found in most large office buildings erected within the last two or three years. The boilers frequently are operated at pressures varying from 5 to 25 lb. Feed, vacuum and house pumps are motor driven, as are the ventilating fans and all other mechanical equipment. The elevators are, of course, electrically operated.

While this type of installation is quite suitable for the average small building requiring up to, say, 1,200 tons of coal a year, it would seem that, in the case of the larger buildings, with consumptions of several thousand tons of coal a year, a certain amount of variation from the above somewhat typical layout would be justified.

In the first place, there appears to be no reason why the boilers in such a building should not be operated at, say, 100 lb. pressure instead of at the low pressures commonly used, since the coal consumption would not be appreciably increased thereby. It would then be possible to operate all the auxiliaries by steam instead of by purchased power, and the exhaust steam could be used for heating. Also, soot blowers could be utilized, and

a net increase in boiler efficiency, due to the employment of high-pressure steam, might be expected. Such auxiliaries as house service pumps, sewage and sump pumps, air compressors, etc, might well be installed in duplicate, one of each being steam driven, the other electrically driven. The electrically driven units would be used during the period when no exhaust steam would be required in the heating system. As one boiler is usually kept under steam during the summer months for hot water and other services, the steam-driven units could always be used in case of a motor or power failure.

By using exhaust steam in the domestic water heaters, the feed-pump exhaust could be utilized in the summer, and it would no doubt be possible to also utilize the exhaust from other auxiliaries for this purpose as well.

To carry the argument a step further, there appears to be no engineering reason why large office buildings should not be equipped with engine-generator sets, which could be loaded so as to produce the exact amount of exhaust steam required for heating and for domestic hot water. This could be done either by operating the engine generator in parallel with motor-generator sets, so as to divide the load properly, or by running the engine generator independently and switching certain portions of the electric load as required by the heating load.

In order to avoid objectionable flashing of lights during such changeovers, it might be desirable to carry the power load only, or a portion of it, on the engines, the lighting load being left entirely on the central station circuit, except during power interruptions.

It might be argued that a high-grade engineering staff would be required to operate such a plant, but in a case where the combined yearly fuel and power bills of a building might run as high as $75,000 to $100,000, it would appear to be only reasonable to employ men capable of controlling such large expenditures.

It is, of course, possible that the plant design of many modern office buildings, due to interlocking directorates and other causes, is largely dictated by matters of policy, but this carries the argument outside the realm of engineering economics.

D. F. GRAHAME.

Montreal, Que.

Cold Working of Boiler Drums

I HAVE READ with considerable interest "The Effect of Cold Working on Boiler Drums" in the June 18 number of *Power*. While it seems to me that the question of strain release is an important factor, I do not believe that it is necessary, providing the thick plates are rolled hot, to go to the annealing temperature after the drum is finished in order to relieve strains. If this is done the drum may go so far out of shape that the stresses added due to distortion may far exceed those which existed before heat-treating.

The fabrication of thin materials cold is a practice which has been successfully carried out for a great number of years, so the remarks of the author apply largely to thick materials.

In Fig. 8 of the article the so-called strain lines seem to show up even at the neutral axis of the piece, and also where the piece is quite straight. It is hardly possible that the materials shown should have exceeded the elastic limit in every part of the cross section. The question in my mind is, "Does this etching really show strain lines, or are there some other phenomena?"

Milwaukee, Wis. T. MCLEAN JASPER.

Installation of Engines Cuts Down Coal Bill

IT WAS WITH considerable interest that I read the article by C. T. Snow in the July 2 number entitled: "Installation of Engines Cut Down Coal Bill. Of course, he does not go into detail, but it appears to me that this is quite a unique plant if it does the things mentioned, and I am sure everyone who read the article would like to know more of how the results were accomplished in this case.

To begin with, I would believe it would be worth while to explain just what item "total direct operating expense" includes. If it is labor, or fixed charges, such as depreciation, interest maintenance, etc., why is it not higher in 1929, when there is several thousand dollars worth more equipment in the plant than there was in 1928? The three engine generators installed will take up quite a bit of space, which probably could be used to advantage for some other purpose. Surely some charge should be made for this space, whether it is placed under direct operating expense or as an indirect expense.

In March of 1929, 41,000 kw.-hr. were consumed over March of the previous year, and it is stated that if the consumption had been as great in 1928 as 1929, the saving would have been approximately $800 more for this month. Similarly, the consumption for April, 1929, exceeded the previous April's consumption, and it is stated that the saving for this month would have been approximately $600 more had the two consumptions been equal.

If this increased consumption would make this much change in the power bill, it means that the power company is making a net charge of 2c. per kw.-hr. The rate used by the power company is not mentioned, but it seems to me that if this is a straight increase in consumption (as we are led to believe), and not in demand, the power bills would not have been increased by an amount anywhere near this figure. The demand for the month had already been established, and any increased consumption would have affected only the energy charge and would have been paid for on the lower steps of the rate.

In looking over the meteorological data given, it seems to me that a more correct method of determining the actual weather conditions would be to determine the number of degree days in the month. In this connection, I might mention that in Pittsburgh we would expect the amount of heat used in March of 1929 to be only approximately 71 per cent of that used in March of 1928. Similarly for April of 1929, we would expect the consumption to be approximately 67 per cent of the April, 1928, consumption. These two figures would seem to indicate that the saving in coal was not due to the installation of engine-generator set but rather was caused by fluctuation in the weather conditions. In the meteorological data given by Mr. Snow it would appear that no account has been taken of the fact that the maximum temperature may have lasted for ten minutes or fifteen days.

The above comments, of course, cover only such general points as we would immediately look for in an installation like this and do not take into account any facts which may be peculiar to this particular case. There must be more data at hand on this job and I, for one, would be interested in hearing more about them.

Wilkinsburg, Pa. A. H. ROBINSON.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

High Velocity Evaporator in Single and Multiple Effects

THE employment of high velocity to effect entrainment separation and elimination of the customary large vapor space are features of the inclined-tube evaporator recently introduced by the Struthers-Wells Company, Warren, Pa.

The evaporator, which is made in single and multiple effects, is particularly adaptable to the production of boiler feed make-up where the scale that is formed consists mainly of calcium carbonate and suspended organic matter. It is also suitable for concentrating or evaporating all liquids with the exception of those which crystallize or salt out during the process.

Fig. 1 shows the general arrangement of the evaporator, and Fig. 2

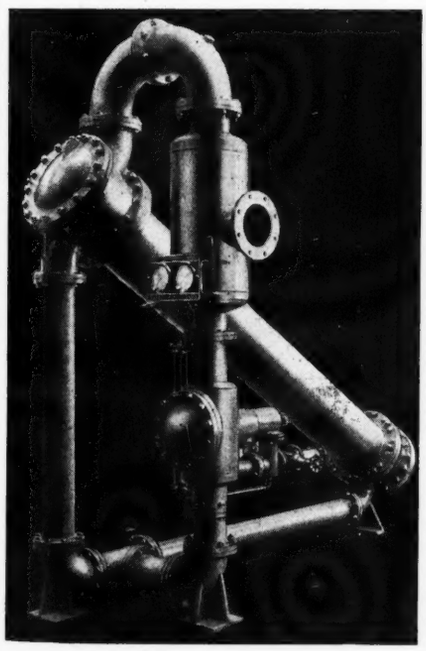


Fig. 1—General arrangement of evaporator

a cross-section of the tube and details of the entrainment separator. As will be apparent from Fig. 2, the unit consists essentially of a tube bundle in a standard-type shell, the whole being placed in an inclined position and fitted with the necessary return connections and separating compartments.

In operation, water or other liquid in the lower portion of the tubes is caused to evaporate and leave the upper end of the tubes at high velocity, striking the top head and throwing down much of the entrained moisture. The vapor, with some entrainment, leaves the vapor head and passes to a separator, where the final separation takes place, the steam

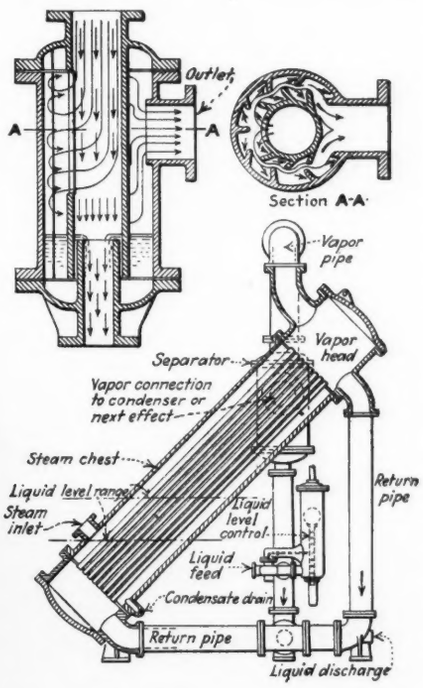


Fig. 2—Cross-section of shell and detail of entrainment separator

passing off to a condenser or to the next effect and the water back to the circulation. Liquid which is thrown downward at the vapor head returns to the evaporator through the return line, indicated in the drawing.

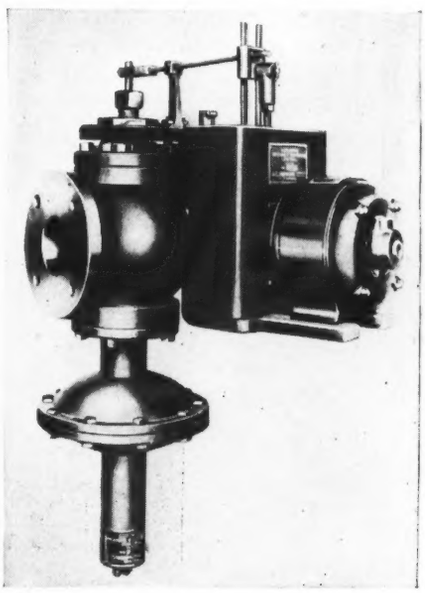
The evaporator is equipped with an automatic feed valve to maintain the desired level. This is placed in the return line from the separator to the circulating system. The separator, shown in detail in the upper view of Fig. 2, employs the principle of parallel-flow separation. Instead of effecting separation by reducing the velocity of the vapor, it causes the vapor to change direction at high velocity, after which it is split into two streams and caused to flow around several specially shaped baffles, as indicated in the detail of Fig. 2.

One of the important fields for the evaporator is said to be in connection with liquids which foam badly. The violence with which the liquid is thrown from the tubes against the vapor head tends to do away with foaming completely. The rapid circulation of the water upward through the tubes and the low hydrostatic head under which the unit operates tend to give it a high evaporating rate.

Zone Heat Control Valve

A CONTROL valve specially designed to provide a ready means of securing different temperatures in different parts or zones of a building or industrial plant and to eliminate overheating, with its resulting waste in fuel, is illustrated.

The control valve functions as a reducing valve and is designed to hold any required steam pressure on



Control valve with motor drive

any particular zone, thus making it possible to use different pressures on the various zones of a building and insure positive circulation without excessive pressure or overheating. Each zone control valve is operated by a mercoid contactor or other thermostat located centrally in the zone supplied by the valve. The thermo-

stats have an operating range of 56 to 80 deg. and are designed to operate on a differential of 2 deg. at any point within the range mentioned. The valve can also be operated by push-button remote control from the engine room or other point in the building.

If desired the thermostats can be cross-connected to control the operation of oil burner, stoker, or draft dampers, so that the firing will be proportional to the heating requirements. The thermostats can also be used to control the operation of the vacuum pump, to maintain a fixed ratio between the steam pressure in the system and the vacuum in the returns or to start and stop the pump as needed.

The motor drive used on the valve employs worm-and-gear type reduction, which has a total reduction of 1,600 to 1. The arrangement of the gears and the use of a spring lever connection to the valve stem precludes the possibility of stalling the motor or jamming the valve. Automatic contactors for the operating valve can be of any two-circuit type, such as room thermostats, water thermostats, pressure controls and fluid-level controls.

The valve, which is put out by the Illinois Engineering Company, Chicago, Ill., can be furnished in standard pipe sizes for 1 to 12 in. suitable for supplying from 300 to 20,000 sq.ft. of radiation.

Self-Contained Unit-Type Stoker

A COMPLETELY self-contained and automatically controlled unit-type stoker designed especially for use with boilers having from 750 to 2,500 sq.ft. of heating surface is illustrated. The design of the stoker makes it adaptable to existing boilers with little or no alteration to the furnace and in most cases without the necessity of excavating for an ash pit.

The grate section is made up of narrow bars placed at right angles to the retort. One bar is shown removed in Fig. 2. The bars are so designed that they present a series

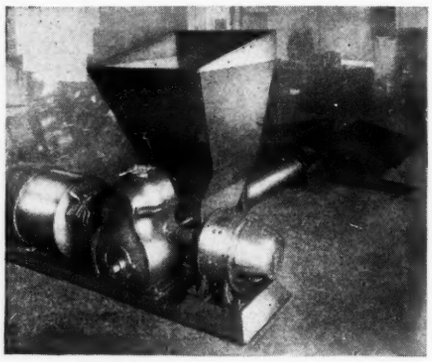


Fig. 1—Stoker assembly

of ribs to the windbox, which tends to keep down the temperature of the bar and at the same time serves to slightly preheat the forced-draft air.

The complete operating unit consists of a totally inclosed motor, ball-bearing gear-reduction unit and a forced-draft fan mounted on a common cast-iron bedplate placed at the front of the stoker. The rear plate of the gear-reduction unit is bolted to the hopper and retort assembly to insure permanent alignment.

A control dial on the top cover of the speed reducer shows the amount of fuel being fed. Eight speeds are provided, which gives a range of feeds from 100 lb. per hour to maximum. Damper controls are placed in a convenient operating position on the side of the fan.

When desired the stoker is equipped with an automatic control designed to maintain any wanted steam pressure within a range of two pounds and readily adjustable to any range desired. The stoker is put out by the General Stoker Corporation, 570 Lafayette St., New York City.

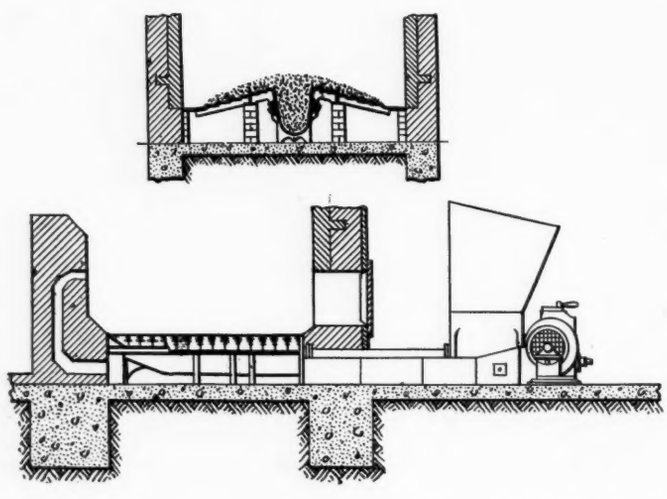
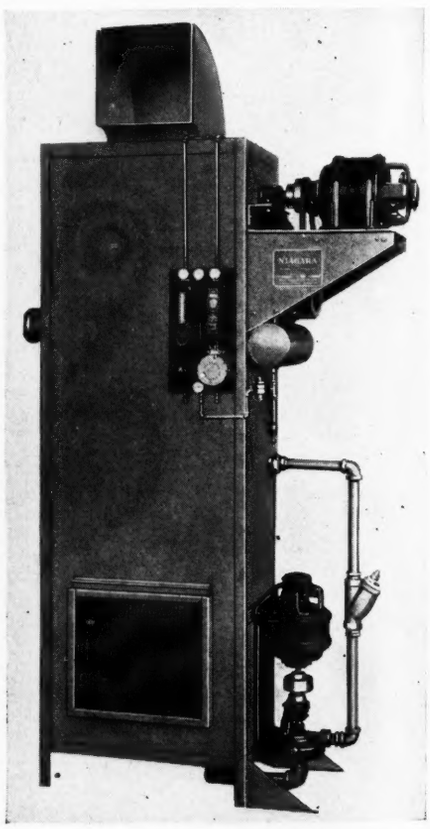


Fig. 2—General arrangement of stoker and cross-section of retort

Air Conditioner With Automatic Control

DESIGNED as a compact and self-contained unit complete with automatic control, the air conditioner illustrated is adaptable to a number of different services, including heating at any given temperature and relative humidity; cooling with the use of refrigeration or cold well water; furnishing moisture or



Self-contained air-conditioning unit

dryness in air for certain processes, as well as cleaning and furnishing ventilating air.

The heating element is an all-aluminum non-corrosive surface with cast aluminum heads designed for 150 lb. working pressure. Tube fin coils are used with the fins knurled on the pipe. Pressure for the water at the spray nozzle is supplied by a

vertical motor-driven pump mounted on the side of the unit. The water is recirculated and the non-clogging type of spray nozzle is used.

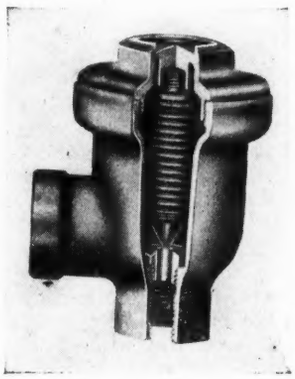
Temperature and humidity controls are mounted on a single panel at the side of the heater, with tube connections to the control points. The fan motor is mounted on a bracket at the side, where it is readily accessible. The casing is of galvanized plates reinforced by angles, and is welded throughout. Where required special non-corrosive material can be used.

Units can be supplied in twelve sizes, ranging from 3,250 to 12,000 cu.ft. of air per min. saturated at 60 deg. The unit is put out by the Niagara Blower Co., 673 Ontario St., Buffalo, N. Y.

Bellows-Type Trap for Process Service

A SMALL, compact steam trap (designated No. 100 Thermoflex) especially adapted for use in all types of process work where the steam pressures range from 0 to 125 lb. and the temperature does not exceed 400 deg., is illustrated.

The bellows, which constitutes the only moving element in the trap, is formed from heavy tubing by a special hydraulic process, requiring an internal pressure on the bellows of several hundred pounds. This gives a bellows of sufficient strength to withstand any water hammer that might be encountered in service. The valve point attached to the bellows is made of nitrided steel, which



Cut-away view of trap

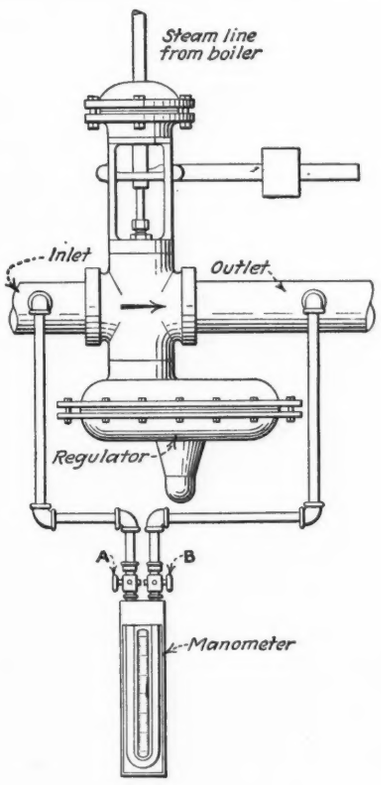
is highly resistant to rusting and scoring. The valve seat is of monel metal and is readily replaceable. The body is of extra heavy cast brass.

The trap, which is manufactured by the W. D. Cashin Company, 35 Hartford St., Boston, Mass., is made in three sizes, $\frac{1}{2}$, $\frac{3}{4}$ and 1 in., with capacities of 500, 650 and 850 lb. of water per hour, respectively.

Manometer As Combined Flow Meter and Pressure Indicator

A MODIFICATION of the regular U-tube manometer, making it suitable for use as either flow meter or as a pressure indicator, is announced by the Meriam Company of Cleveland, Ohio. The illustration shows the instrument applied to a differential control system for gas and steam pressure, as used with a gas-fired boiler. There are many other types of equipment in the power and industrial plant fields to which it can be applied.

As with all manometers, the instrument operates on the differential



principle, whether rate of flow or actual pressure is indicated. When used to read pressure of liquids or gases, one of the arms is connected to the atmosphere and the other to the source of pressure to be measured. The difference produced in the liquid levels in the two arms shows the difference between the pressure measured and that of the atmosphere. Each inch of difference in level indicates 0.036 lb. per sq.in. pressure if the liquid used is water, or 0.491 lb. if mercury is used.

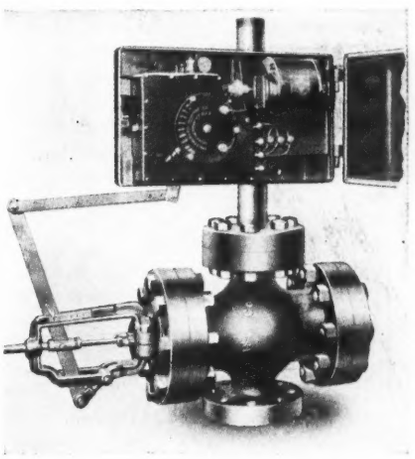
When used to indicate flow of liquids or gases, the two U arms are connected one on each side of an orifice in the pipe line whose flow is to be measured. The orifice of known size produces a definite drop of pressure for a given rate of flow, the drop being shown on the manometer, which is calibrated to read rate of flow.

In the arrangement shown in the illustration, if the cock *A* is open and the cock *B* closed, the manometer is between the gas line and the open air, and therefore reads gas pressure. With the reverse arrangement, the cocks closed, the manometer is connected to show pressure across the regulator, or, if a double scale and the measuring disk be also provided, the rate of steam flow.

Flow Control for High Pressures and Temperatures

THE flow-control valve illustrated is adaptable to the control of high-pressure steam, water, process liquors or gases, although designed primarily for use in the oil-refining industry.

The control, which is a product of the Brown Instrument Company, Philadelphia, Pa., embodies a forged-steel manometer in the electric flow meter put out by the company and



Flow-control valve with operating mechanism

a specially designed remote control valve with automatic control device mounted as shown, above the valve. The unit illustrated is designed to operate at 1,300 lb. pressure and 600 deg. temperature. Controls with valves suitable for any pressure up to this point are obtainable.

FROM AMONG READERS' PROBLEMS

Conducted by L. H. MORRISON

HEAD ON OILING SYSTEM—*A gravity-feed storage tank 16 x 14 x 28 in., fitted with internal overflow, capacity 25 gal., elevation 17 ft., was replaced by a tank 28 x 28 x 58 in., capacity 200 gal., elevation 15 feet.*

There are three ½-in. valves, one ¾-in. valve and two ⅜-in. valves opening into the turbine-oiling system. The outlet from the large tank is 1½ inches.

Could not the smaller tank have been fitted with a 1½-in. outlet and have handled the demand?

Supposing the smaller tank had been fitted with the 1½-in. outlet, is it not true that the oil pressure would have been greater at the valves leading to the turbine-oiling system?

It is claimed that with the larger tank more oil will flow to the turbines, but is it not true that if a tank of unlimited dimensions be installed, with the elevation remaining the same, with the same size valves used at the turbine and with any size outlet from tank above 1½-in. diameter, the amount of oil delivered to the turbines will remain the same?

R. C. S.

On the assumption that the lubricating-oil pump is of sufficient capacity to return the oil from the pump at a rate such that the tank's oil level is maintained constant, then the question as to which tank should deliver more oil depends upon the height of the oil level in each tank. Assume that the overflow is four inches from the top of the small tank, which is 28 in. deep, then the head will be 17+2=19 ft. If the overflow in the 58-in. high tank is also four inches from the top, the head would be

$$\frac{15+54}{12}=19.5.$$

The difference in flow would be negligible. Of course if the position of the overflow or the height of the oil in the tanks were at the same level above the floor there would be no difference in the flow.

ECONOMY OF A TRAP—*Is a trap as economical as a steam pump for boiler-feed handling?* C. A. B.

If the vent from the trap can be connected to the same place as the exhaust of the boiler-feed pump, for instance, at the heater or at the return lines from the heating system, it should be as economical as the feed pump. If the pump had no clearance in the steam cylinder, the amount of steam needed to handle the water would be the same as the volume of steam needed to operate the trap. But the clearance increases the pump steam, so theoretically the trap should be more economical.

INSTALLING ECONOMIZER WITH A SMALL BOILER—*I am operating a 1,500-sq.ft. horizontal tubular boiler at full rating. Feed water is handled by a duplex steam-driven pump at 212 deg. F. Would it pay to install an economizer? The boiler is stoker fired, with forced and induced draft.* H. R. C.

Ordinarily, in boilers of this size, the cost of the economizer is too high to justify the installation. Much however, depends upon the stack-gas temperature. If you are losing much heat it might pay to install an economizer between the pump and boiler to raise the feed water to a higher temperature. Correct firing will hold down the stack temperature.

HEATING BY STEAM AND HOT WATER—*We are operating a boiler at 85 lb. gage and are using the steam at 5 lb. gage in our heating system. Would it be more economical to change the boiler to hot-water heating?* V. H.

In most cases radiators are installed to heat the building with steam at a definite pressure. If hot water is used, the amount of radiator surface may be too small. On the other hand, hot-water heating gives a better control of the room temperature, and the engineer can regulate the temperature; whereas with steam the user of a room is inclined to open the windows when the room is too warm.

PREVIOUS QUESTION

DISCUSSED BY READERS

THE QUESTION

HOW can we obtain clean steam for dye vats from the exhaust of our reciprocating engines?

P. S. W.

THE principal objectionable matter in exhaust steam is spent lubricating oil; this may either be in suspension or in the form of an emulsion, according to whether the oil is straight mineral or compounded. If the former, separation of the oil from the exhaust steam is possible; in the latter, separation is very difficult, if at all possible, without resort to chemicals.

To gain the desired end—clean steam—use only a straight mineral cylinder oil that will not emulsify. Then use that oil in minimum quantity, with a controlled feed.

A controlled feed means the use of a mechanical force-feed lubricator. At the beginning discover just how little oil is absolutely necessary to supply the valves and cylinder of the engine with lubrication.

Next, consider some type of oil separator that can be placed in the exhaust line to take care of the small quantity that may be expected to come through with the steam.

The big point is—a controlled minimum feed of an oil that will not emulsify. CHARLES J. MASON.

Brooklyn, N. Y.

IF AN elaborate oil separator will not result in sufficiently clean steam for dye vats when exhaust steam from a reciprocating engine is to be used, it will be necessary to use a heat exchanger or evaporator, with the engine exhaust on one side and a source of pure water on the other.

With the evaporator system it will be necessary to increase the engine's back pressure to, say, 10 lb. in order to get the necessary heat gradient from steam to water. R. S. LANE.

New York City.

THE solution of the problem begins with the selection of suitable oil. The working of the devices used for the separation of steam and oil is based on the fact that steam is gaseous, while the oil mixed with it is present in form of liquid drops. Low-grade oils, however, often contain tallow or other cheap fat. These usually have low evaporating temperature and are likely to be present in the exhaust steam in form of vapors, consequently no ordinary separator is able to separate them from the steam. For this reason it is advisable to use pure mineral oils having evaporating points of not less than 600 deg. F. This is much higher than the temperature of, say, 220 deg. F. of the exhaust steam.

As to the separator itself, I know one type that seems to surpass by far all others. It is a German make and consists of an internal-shot turbine wheel, that is, a wheel into which the steam

flows along the shaft, like the air into a centrifugal ventilator, revolving around a vertical axis, and driven by the steam itself. The centrifugal force caused by the rotation throws the drops of oil against the grooved inner surface of the casing, where, under the influence of gravity, they flow to the bottom and are removed through a trap. The steam leaves the casing through a pipe connection. The Bavarian Society for Boiler Inspection conducted a series of comparative tests with a great number of separators. The centrifugal separator proved to be three to five times as efficient as the others.

ANDREW A. BATO, M.E.
Consulting Engineer.
East Orange, N. J.

—◆—

I AM going to tell of a simple device that has proved successful on the exhaust line of two 3,500-hp. Corliss rolling mill engines in preventing blade corrosion in three 1,000-kw. mixed-pressure turbines.

This device is simply a large tank filled with coke, with the exhaust inlet on the side, near the bottom, and the exhaust outlet on the opposite side, near the top. The steam in passing upward through the coke is freed of all cylinder oil and a low-pressure trap removes the oil and condensation from the bottom of the tank; the coke need be renewed only about once every five years.

This might be satisfactory in removing oil from steam going to dye vats.

EDGAR P. WANNER.
Lancaster, Pa.

—◆—

ONE of the most important things in connection with the elimination of oil from exhaust steam of engines and pumps where the exhaust is to be used in processes is to use a high-grade straight mineral oil. If for any reason a compound oil must be used, the percentage of compounding should be very slight.

A high-compound oil forms an emulsion with the moisture in the steam, which is difficult to remove. On the other hand, a straight mineral oil lends itself to separation from the steam in passing through the oil separators.

In addition to using a good grade mineral oil adapted to the pressure and temperature conditions of the steam, it is advisable to use an oil separator on the exhaust line having sufficient cross-sectional area to reduce the velocity of the steam, in order that a more complete separation of oil and water will occur.

It is also advisable to place a section of larger-diameter pipe next to the separator and between the separator and engine, as this will reduce the velocity considerably before the steam actually enters the separator. The bottom of this pipe should be drilled and tapped and provided with a drain for any oil and water deposited.

Some years ago I had difficulty with oil from the exhaust entering a surface steam condenser which operated under a vacuum of 26 in. and whose condensate was being used in a distilled-water ice-making plant. The trouble was overcome by placing a 14-in. oil separator on a 10-in. line, in addition to inserting approximately 10 ft. of 14-in. piping next to the separator. The section of pipe, as well as the separator, had drains connected to a vacuum trap, which automatically discharged the oil and condensate to the sewer.

We found it necessary to change from a compound to a mineral oil. Thereafter no difficulty was experienced with oil in the condensate leaving the surface condenser.

C. T. BAKER.
Atlanta, Ga.

A Question For Our Readers

IS IT advisable to install centralized temperature control in a hotel or office building. G. R. P.

Suitable answers from readers will be paid for and published in the Sept. 24 issue.

IT IS my belief that there are no steam separators on the market that will remove all oil and impurities. There are many that claim to remove 99 per cent of the water and entrained impurities, but in practice they generally turn out to be less than the maker claimed.

Assuming the exhaust pressure to be about 5 to 10 lb., one possible solution is to use first a high-grade steam cylinder oil having no volatile vapors at steam temperatures.

Next, connect up an ordinary baffle-type separator and exhaust the drain to the atmosphere, not to a trap. The discharge from this can then be led to a separator having low velocity passages and micrometric openings. Such traps, I believe, are guaranteed to deliver 100 per cent dry steam. The purpose of the two separators in series is to remove enough of the oil and water in the first one to enable the second one to function without stopping up. The second, being a more refined piece of equipment, will remove most of the "last trace."

We have found, in practice, that far more oil is removed from the steam by the ordinary centrifugal or baffle separator when the drain is continually exhausted at reduced pressure than when it is led to a trap. If steam is absolutely free from small particles of water, there is not much chance of oil being carried along with it.

JOHN N. NORRIS,
Power Engineer,
John Deere Tractor Co.
Waterloo, Iowa.

SOME soda or other chemical used for treating the feed water may be found in the exhaust steam, but the greatest trouble is caused by the oil, which must be removed mechanically by a separator placed in the exhaust line ahead of the vat. The amount of chemicals in the steam may be reduced to a minimum by careful attention to the boiler water.

There are a number of first-class mechanical oil separators on the market. The oil, which is in the form of fine drops or is emulsified with the moisture in the steam, is carried along by the steam very much as entrained moisture. As the density of the oil is much greater than that of steam, the oil may be removed by a sudden change in direction of flow. In the usual separator this is accomplished by reversing the flow of the exhaust steam, by centrifugal force (obtained by giving a swirling motion to the steam), or by placing baffles in the path of the steam. Other separators filter the steam through beds of coke or broken tile.

The filter types need more attention than the mechanical types, as the filtering materials must be kept clean. However, with a good clean condition they give almost perfect separation. The efficiency of an oil separator decreases with increased steam velocity. As the steam velocity in a low-pressure line is usually higher than that in a high-pressure line, care must be taken to design the separator large enough to maintain a fairly low steam velocity through it. Use of a good grade of oil in the engine will reduce the amount of oil picked up by the steam.

The heat from the exhaust steam may be utilized in two ways: Condensed directly in the dye solution or transferred through a closed coil.

When steam is condensed directly in the vats, it is necessary to remove as close to 100 per cent of the oil as possible. An efficient separator must then be used. A combination of the baffle and filter types is the best for this purpose. The oil that does escape through the separator may be coagulated and precipitated by alum in the dye solution. This method is sometimes objectionable, as the precipitate is apt to become deposited in the material being dyed.

On the other hand, the steam may be condensed in closed pipe coils submerged in the dye solution or surrounding the vat. As the heating medium is kept out of contact with the solution, there can be no contamination. This system necessarily entails a higher back pressure on the engine, with the consequent loss of power. The exhaust steam before entering the heater element should be sent through an oil separator, which need not be as efficient as that needed in the open system. If the separator is used, the amount of cleaning of the heater coils will be reduced to a minimum. In this system the condensed steam is saved and may be returned to the boiler as boiler feed; the usual heater will remove the oil in the condensate.

WILLIAM WELCH, JR.
New York City.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Spot * News

TYING IN *of the last link in the American Gas & Electric Company's 980-mile superpower system was effected recently with the completion of the 132,000-volt transmission line between Philo and Fostoria, Ohio. The new hook-up, which has a load interchange capacity of 100,000 hp., between superpower plants extends from Lake Michigan to North Carolina.*

* * *

TO IMPROVE *the heat balance of their department store steam power plant during the summer months, R. H. Macy & Company of New York City have just ordered two 1,000-hp., eight-cylinder Diesel engines from the Fulton Iron Works for immediate installation.*

* * *

PUBLIC UTILITY *net earnings, exclusive of telephone and telegraph companies, for the first six months of this year amounted to $507,500,000, as compared with $430,362,385 for the same period in 1928, according to a recent announcement of the Department of Commerce.*

* * *

A PARACHUTE *was recently the means of supplying needed parts for a Diesel engine upon which the town of Booneville, Ky., depended for its lights. To expedite repairs the parts had been shipped by airplane, but when the plane arrived it was unable to make a landing, so delivery was completed via parachute.*

* * *

THE S.S. "WEST ALSEK," *which is equipped for burning powdered fuel, is returning from a trial trip to Great Britain with her bunkers filled with hard Welsh coal. She was a source of great interest to British engineers during her stay in England.*

* * *

DEVELOPMENT *of a new metal known as "Konel," which is credited with being much stronger than other metals at high temperatures and which can be used extensively in the moving parts of internal combustion engines and other extremely hot places, has been announced by the Westinghouse Electric & Manufacturing Company.*

N.A.P.E. to Hold 47th Convention at Chattanooga, Sept. 9 to 13

Addresses by Prominent Officials, Discussions of Problems, 1929 Power and Mechanical Exhibition, Trips to Industrial Plants and Entertainment Amid Scenic Beauty Will Enliven Program

Hotel Patten, Convention Headquarters

ANTICIPATING a lively business and entertainment program, the members of the National Association of Power Engineers will gather at Chattanooga, Tenn., on Sept. 9 for their 47th annual convention, the first to be held in the South. Besides delegates officially representing the many N.A.P.E. branches throughout the country, a large attendance of individual members, friends and manufacturers' representatives is expected. The Hotel Patten has been selected as convention headquarters, but registration will take place at the exhibition hall.

Seven business sessions and many entertainment features are scheduled on the tentative program. Addresses by national officers and prominent men, committee reports and discussions are features of the meetings, while trips, social functions and outdoor sports will provide enlivening recreation. There will be ample time to take in the scenic beauties, historical points of interest and some of the leading industrial plants in and around Chattanooga. Of particular interest to power engineers are the Hedges-Walsh-Weidner boiler manufacturing plants located in the city and the 54,240-hp. Hales Bar hydro-electric and stand-by steam plants, twenty miles down the Tennessee River from Chattanooga.

During the entire five days of the meeting the 1929 Power and Mechanical Exposition will be held in conjunction with the convention by the National Exhibitors' Association at the Soldiers' and Sailors' Memorial Auditorium. This auditorium has been called one of the three greatest structures of its kind in America. Measuring 155x280 ft., the building has a main hall seating 5,500, a smaller theater seating 1,500 and an exhibition room 151x172 ft. A total of over 70,000 sq.ft. of exhibiting space is available, in which manufacturers will display an imposing array of the latest power equipment and auxiliary apparatus.

The following is a summary of the program for the five days of the 47th annual convention, Sept. 9 to 13, inclusive:

Monday, Sept. 9

9 a.m. to 9 p.m.—Official registration of delegates, exhibitors and visitors at Memorial Hall.

7:30 p.m.—Official opening of exhibit hall. Address of welcome by I. S. Pieters, president of the Exhibitors' Association. Response by Thomas R. Herlihy, national president of the N.A.P.E.

10:15 p.m.—Informal reception and dance at Hotel Patten, convention headquarters.

Tuesday, Sept. 10

8:30 a.m. to 8:30 p.m.—Official registration.

10 a.m.—Opening of 47th annual convention N.A.P.E. in theater of Memorial Auditorium, where all official sessions will be held. Welcome from State of Tennessee by Governor H. H. Horton. Response by National President T. R. Herlihy. Welcome from City of Chattanooga by Mayor E. D. Bass. Response by National Vice-President J. A. McDevitt. Address, to be announced later. Response by Past National President Elmer L. Bassett. Address by W. D. Reynolds, chairman of board of trustees.

12:00 noon—Official opening of N.A.P.E. Convention. Reception to the flag, by F. W. Raven, national secretary. Naming of convention committees. Official photograph.

1:30 p.m.—First session of convention: Reports of credentials committee. Report of national president, national

vice-president, treasurer, educational committee and license law committee, open session.

Wednesday, Sept. 11

9 a.m.—Second session: Final report of credential committee and other committee reports.

10:30 a.m.—Reports of state and United States deputies and interim committee reports.

1 p.m.—Third session of convention; Reports of committees and general work.

2:30 p.m.—Visit to Hedges-Walsh-Weidner plants.

8:00 p.m.—Annual entertainment by Exhibitors Association.

Thursday, Sept. 12

9:30 a.m.—Fourth session of convention: Final committee reports and discussion on good of the order. Lecture.

11:30 a.m.—Memorial services.

1:30 p.m.—Fifth session of convention: General work.

3:00 p.m.—Visit to Lookout Mountain. Refreshments.

Friday, Sept. 13

9:30 a.m.—Final session of convention: Election of officers. Selection of next convention city. Installation of officers. Payment of mileage.

9:00 p.m.—Annual ball.

Foreign Delegates to World Congress Will Arrive Soon; American Representatives Named

Delegations appointed to represent the different European nations at the coming World Engineering Congress in Japan will shortly begin arriving in this country to join the American delegation, which sails from San Francisco on Oct. 10. Instead of proceeding directly eastward, the Europeans are taking this opportunity of visiting the United States, where many of them will spend several weeks inspecting mines, industrial plants and engineering institutes. Others, however, will pass their time in pleasure trips to the bigger cities and such show spots as the Grand Canyon.

A New York City committee, headed by Roy V. Wright, president of the United Engineering Society, will arrange for their reception in New York and their entertainment while in the city. The first arrival here will be Dr. C. Matschoss, director of the Verein Deutscher Engenier, Berlin, who will land on Sept. 2 prepared to make an extended trip through this country in company with Dr. Karl Kootgen, general director of the Sieman-Shuckert Works, Berlin. England, Italy, Sweden, Denmark, France, Belgium, Yogoslavia and Germany will send engineers to this country prior to the Tokio congress, about 100 visitors being expected.

Sixty officials delegates appointed by the four great "founder" engineering societies of the United States and other national engineering organizations will be included in the American delegation, which altogether numbers about 250 members. Among those named are: Elmer A. Sperry, president of the A.S.M.E. and chairman of the American Committee of the World Engineering Congress, New York; W. H. Carrier, American Society of Refrigerating Engineers, Newark; John V. N. Dorr, Engineering Foundation, Pittburgh; William Elmer, vice-president, A.S.M.E., Philadelphia; Byron E. Eldred, consulting engineer, New York; John R. Freeman, consulting engineer, Providence; D. C. Jackson, M.I.T., Boston; Major General Edgar Jadwin, Washington; Charles T. Main, president of the American Institute of Consulting Engineers, Boston; O. C. Merrill, chairman of the American Committee of the World Power Conference, Washington; Calvin W. Rice, secretary, A.S.M.E., New York; David Rushmore, New York; R. F. Schuchardt, chief engineer, Commonwealth Edison Company, Chicago; C. E. Skinner, assistant director of research Westinghouse Electric & Manufacturing Company, East Pittsburgh; Charles W. Stone, General Electric Company, Schenectady; and Francis Lee Stuart, Engineering Foundation, New York.

N.A.P.E. local convention committee

Left to right—William Reottker, treasurer; George Smith, booth sales; A. O. Berry, advertising; E. H. Schiempf, chairman; Charles Kimble, publicity; Earl E. Wright, secretary.

Boiler Plant Remodeled for Underwood Co. at Hartford

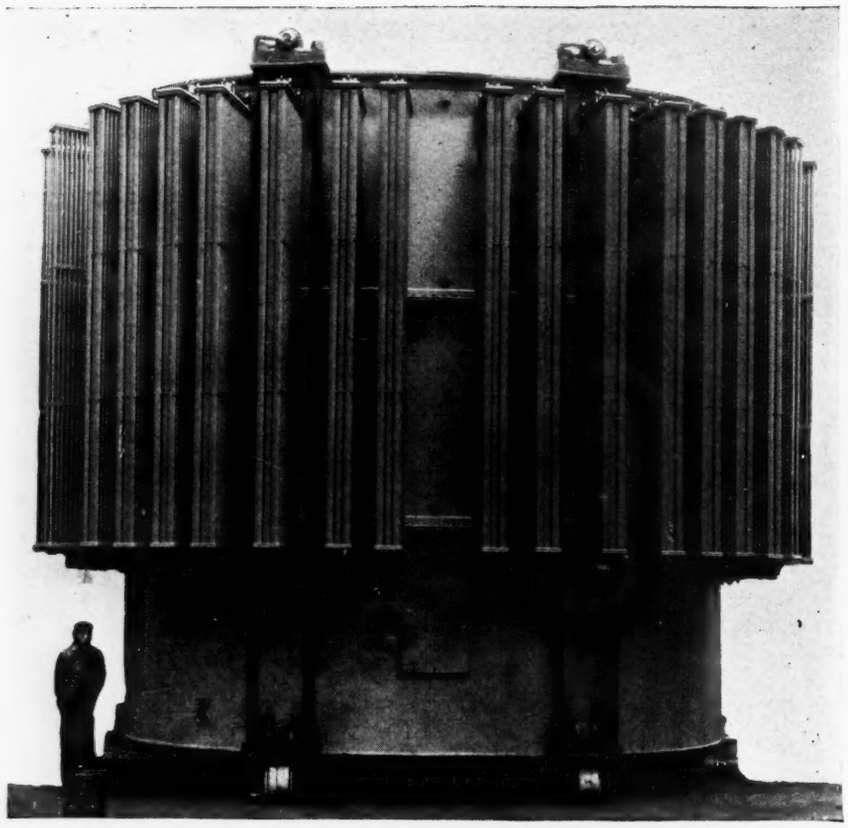
Modernization of the boiler plant of the Underwood Elliott Fisher Company at Hartford, Conn., is practically completed at the present time; only a few finishing touches remain to be put on. The plant contains three 6,000-sq.ft. Stirling boilers with Riley underfeed stokers. It was built on the same site as the original plant, which was equipped with five H.R.T. boilers and two Manning boilers. Full capacity of the old plant was required at all times, so that no part of it could be shut down until the new boilers were ready to take over the load.

Construction work was started the latter part of July, 1928, and the first new boiler was put into service Dec. 10. Three of the old boilers were then shut down and the second new boiler pushed to completion; this boiler being put on the line early in January. The remainder of the old boilers were then taken out and the third new boiler put in. One of the old boilers has been reset as a rubbish burner, using the old chimney for its stack. A new 200-ft. chimney was built for the new boilers.

The design and supervision of the plant was under the direction of Lockwood Greene Engineers, Inc., and H. L. Crosby, resident engineer. P. R. Spencer is chief engineer for the Underwood Elliott Fisher Company.

New Power Plant for DuPont Rayon Company

The power plant of the DuPont Rayon Company at Waynesboro, Va., started recently, with three boilers of 8,500 sq.ft. each put into full operation. It is equipped with two 3,000-kw. turbine-generators to supply power and light for the entire factory. The power house is 111 ft. x 120 ft. and is 72 ft. high, with a concrete foundation supporting the steel superstructure. The stack stands 250 ft. high and has an inside diameter at the top of 11 ft. Coal is stored in an outside stock pile and is brought in on dragline conveyors to large concrete silos, 19 ft. in diameter and 68 ft. high, with a capacity of 200 tons each. The coal is then pulverized for firing the boilers.



World's Largest Transformers Present Shipping Problem

STRENGTHENING of bridges and lowering of railroad tracks, eighteen inches at one point, to permit clearance will be necessary to transport the four largest electric power transformers ever built from the Westinghouse Electric & Manufacturing plant at Sharon, Pa., to Roseland, N. J., near Newark. Shipment will be made within the next few days.

The world's largest transformers will be used to transfer power at the Pennsylvania Power & Light Company's plant at Bushkill, Pa., to the Public Service Electric & Gas Company's system in New Jersey. Fifty-six freight cars will be necessary to carry the transformers and parts over the Erie Railroad.

An army of men almost equal to that required to move a three-ring circus will load and prepare the huge transformers for shipment. Each transformer is 35 ft. high, weighs approximately 300 tons, and requires a floor space 22 x 23 ft. More than three tank cars of oil, or 32,000 gal., will be required to fill each transformer.

The transformers are rated at 220,000 volts, but were tested at 570,000 volts, the highest ever applied to a power transformer. The core and coils in each transformer contain 63 tons of laminations and 15 tons of copper windings. There are more than 32 miles of wire in the copper windings in each.

Winding capacity of the four transformers is sufficient to furnish power to illuminate 6,000,000 40-watt incandescent lamps, the kind most used in home illumination, or a total of approximately 200,000 ordinary six-room houses, or all the homes in a city larger than Cincinnati, Ohio, according to estimates of Westinghouse engineers.

The weight of each transformer as prepared for shipment is 270,000 lb., one of the heaviest individual units ever shipped on single railroad cars. It was necessary to utilize a special depressed type of equipment to permit clearance under vehicular and cross-line bridges along the right of way. To further meet the requirements, the tracks at Caldwell, N. J., will be temporarily lowered 18 inches.

General Jadwin Disagrees on Disposal of Potomac Project

Recommendation that a preliminary permit be granted the Potomac River Corporation, of Wilmington, Del., for ultimate development of a hydro-electric power project at Great Falls, Md.-Va., on the Potomac River, was made to the Federal Power Commission by Major General Edgar Jadwin, before he retired on Aug. 12. That the parks "should fit into the scheme of the nation and not the nation into the scheme of the parks" is one of the points made by him in submitting minority views on the report of the national capital park and planning commission. The other members took the position that it would be "inadvisable to decide now upon the destruction for all time of the scenic and recreational assets of such large prospective importance as those included in the valley of the Potomac at the doors of the national capital. "These reports will be submitted to Congress for final decision.

General Jadwin concurs in the report of the district engineer, Major Brehon B. Somervel, who estimates the cost of power produced at Great Falls under the plan submitted by the Potomac River Corporation at approximately $1,000,000 a year less than the equivalent steam power. The various potential values that would result from a national development of resources of the Potomac aggregate $48,000,000 as follows: (a) savings on production of hydro-power instead of steam power, capitalized on a 6 per cent basis at $15,000,000; (b) saving by elimination of two bridges, $3,000,000; (c) savings in the form of income from taxes at the rate of 2 per cent capitalized at $14,000,000; (d) savings which the power structures would produce if navigation should be extended up the Potomac River, amounting to $14,000,000; (e) savings on preliminary treatment of the Washington water supply and estimated value of flood protection $2,000,000.

"The decision lies," General Jadwin says, "between a park prodigal of the latent resources of the Potomac and an equally good park conserving these resources. Combined park and power development is feasible and the waste of more than $48,000,000 of potential values for debatable minor scenic consideration is neither necessary, desirable nor sound."

The majority of the park and planning commission reports that the combined park and power projects would result in a totally different kind of park from the natural valley. The price of creating this different and less valuable kind of park would not merely be a matter of dollars. Years will be necessary for the scars to heal and would cause the destruction for all time of the essential characteristics which make the present natural river valley unique and distinctive.

Diesel Plant to Be Enlarged at Pecos, Texas

Construction work on the $200,000 addition of the Texas-Louisiana power plant in Pecos, Texas, was started recently. A new 2,500-hp. Nordberg, two-stroke-cycle Diesel engine is to be installed, which will double the capacity of the plant. A special foundation is being constructed for the new unit, which weighs 340,000 lb., and is being shipped to the plant in fifteen cars. The great increase of power demands in this area within the last two years since the half million dollar plant of the Texas-Louisiana Power Company was completed has made the addition necessary.

Engineers Will Study Themselves to Improve Their Status

Engineers are to study themselves with the aim of improving the status of their profession and of uncovering new possibilities for the betterment of society, it is announced by the American Engineering Council. Earnings will be analyzed, a yardstick will be applied to the engineer as a professional man, the trends of engineering thought explored, and machinery devised to adjust relationships of engineers whenever difficulties arise, nationally or locally. Fresh objectives for the profession as a whole will be set up.

Engineers are presumed to be analyzers and planners, and therefore it is logical to believe that by analyzing their own calling they can perform a constructive service both to themselves and to the public, declared the announcement by Arthur W. Berresford, of New York, president of the council.

Appointment of a committee on engineering and allied technical professions to direct the study under the auspices of the council was also announced by Mr. Berresford. The chairman is H. C. Morris, retired mining engineer, of Washington, D. C. Other members are: A. B. McDaniels, of Washington, representing the American Society of Civil Engineers; Conrad N. Lauer, of Philadelphia, the American Society of Mechanical Engineers; H. A. Kidder, of New York, the American Institute of Electrical Engineers; L. W. Wallace, of Washington, executive secretary of the American Engineering Council.

Committees from the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Washington (D. C.) Society of Engineers will work with the committee, whose findings, it is expected, will enable the council, organized ten years ago under the headship of Herbert Hoover, to enter upon a program of professional advancement.

J. H. Lawrence Elected President of Thomas E. Murray, Inc.

At a meeting of the directors of Thomas E. Murray, Inc., John H. Lawrence, vice-president and manager of the company since its organization, was elected president.

After his graduation from Cornell University Mr. Lawrence was employed in the engineering department of the New York Edison Company. In 1919 the late Thomas E. Murray, in order to consolidate the various consulting engineering activities he had engaged in for many years, formed the company which bears his name, and selected Mr. Lawrence as active head in charge. Many of the largest power stations in the country have been designed by the company, including the East River station of the New York Edison Company, the Hell Gate station of the United Electric Light & Power Company, the Hudson Avenue station of the Brooklyn Edison Company, as well as power stations for Albany, Utica, Dayton and other cities. The monumental office building of the Consolidated Gas Company and many industrial buildings in various parts of the country have been designed and erected under the direction of the company. The engineering of projects for several large industrial concerns is now

John H. Lawrence

being carried on, involving the erection of many power plants.

Mr. Lawrence has long been recognized as an authority on power plant design. His analytical method of determining the most economical plant focused attention upon the importance of the heat balance calculation as a preliminary in the rational solution of the design. He was one of the first to develop and apply this method, which has since been adopted in designing all leading plants. He has contributed largely to the advance in power plant design of recent years which has resulted so materially in reducing the cost of power production. Mr. Lawrence is the holder of many patents covering improvements in power plants. He has presented many papers before engineering societies, dealing chiefly with various phases of power plant design and construction, and has been a lecturer in the Engineering School at Cornell University.

Mr. Lawrence is a member of the Engineers Club of New York, and is widely known in the engineering profession. He is a member of the American Institute of Science, and has been active in various engineering societies, having served on many important committees. He is a member of the Power Generation Committee of the American Institute of Electrical Engineers. He has been chairman of the professional divisions and chairman of the metropolitan section of the American Society of Mechanical Engineers. He is at present vice-president of that society and a member of its executive committee. He has recently been nominated as delegate to the American Engineering Council.

OBITUARY

MERTLAND MCCLAIN HEDGES, one of the founders of the Casey-Hedges Boiler Company, Chattanooga, Tenn., died a few days ago at the age of 69 years, following a protracted illness. Mr. Hedges retired from active business life some time ago when the Casey-Hedges Company merged with the Walsh Weidner Boiler Company. He was for a number of years a prominent member of the Southern Metal Trades Association, and held several offices in this organization at various times.

JAMES T. HUTCHINGS, vice-president of the United Gas Improvement Company in charge of the engineering development, died suddenly on Saturday, Aug. 17, at Ocean City, N. J. Mr. Hutchings had gone to the seashore for the week-end after working in his office until late Friday afternoon apparently in good health. Heart disease was the cause of the death. Born in Amherst, Mass., in 1869, he attended Amherst public schools and was graduated from Massachusetts Agricultural College with the degree of bachelor of science in 1889. His first position after graduating was with the Thomson-Houston Electric Company of Amherst, in which he remained about four months. In that same year he came to Philadelphia to accept a position as foreman of wiring with the Germantown Electric Company, and later became superintendent of the West End Electric Company. Mr. Hutchings entered the employ of the United Gas Improvement Company in 1920 as assistant general manager, after having been connected with the Rochester Gas and Electric Corporation for sixteen years. In 1921 he became general manager, and two years later was elected vice-president.

PERSONALS

W. G. JENS, formerly manager of the Pittsburgh branch of Byllesby Engineering & Management Corporation, has been appointed operating manager of the Duquesne Light Company at Pittsburgh, Pa.

F. D. NEWBURY, manager of the Power engineering department of the Westinghouse Electric & Manufacturing Company, East Pittsbrugh, Pa., has been appointed chairman of the Standards Committee of the American Institute of Electrical Engineers.

A. H. DAVISON, formerly of the Sherman Island, N.Y., hydro-electric plant of the International Paper & Power Company, has resigned to accept a position with the United States War Department, in connection with a

project study of the Connecticut River with special reference to flood control and hydro-electric development.

PRICE M. GREENLAW was recently reappointed inspector of boilers by the district commissioners of Washington, D. C., for a two-year period.

PROFESSOR WILLIAM MCPHERSON, dean of the department of chemistry in Ohio State University, will be president of the American Chemical Society for 1930 as a result of a special election. He will succeed Dr. Irving Langmuir, assistant director of research of the General Electric Company, Schenectady, N. Y.

E. J. SCHWANHAUSSER, for the past two years assistant manager of the Harrison, N. J., works of the Worthington Pump & Machinery Corporation, has been appointed manager of that company's Buffalo, N. Y., plant.

J. F. LINCOLN, president of the Lincoln Electric Company, recently sailed on the Leviathan for London, where he will take charge of a demonstration for European engineers of the "electronic tornado" process of carbon arc welding.

A. G. BUTLER, formerly general superintendent of construction for the Louisville (Ky.) Gas & Electric Company and in charge of the construction of the recently completed 80,000-kw. hydro-electric station at the falls of the Ohio River, has succeeded W. C. Jens as manager of the Pittsburgh branch of the Byllesby Engineering & Management Corporation.

Coming Conventions

American Institute of Electrical Engineers. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. District meeting at Chicago, Ill., Dec. 2-4. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Mechanical Engineers. Annual meeting at New York, N. Y., Dec. 2-6. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

American Welding Society. Fall meeting at Cleveland, Ohio, Sept. 9-13. Secretary, M. M. Kelly, 33 West 39th St., New York City.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

New England Water Works Association. Annual convention at Hotel Eastland, Portland, Me., Sept. 17-20. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Third National Fuels Meeting at the Bellevue-Stratford Hotel, Philadelphia, Pa., Oct. 7-11.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

Business Notes

INTERNATIONAL COMBUSTION TAR & CHEMICAL CORPORATION, New York City, announces the election of George E. Learnard as chairman of the board of directors, succeeding F. J. Lewis; of Dr. Walter Runge as president, succeeding W. H. Lewis, and of Grant Thorn as vice-president in charge of sales.

ASHTON VALVE COMPANY, Boston, Mass., has recently appointed the following sales agencies: Smiley Equipment Company, Kansas City, Mo.; Consulting Engineering Company, Pittsburgh, Pa., and Williamson & Woody, Richmond, Va.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has placed contracts for the erection of an addition to the present plant which will add about one-half acre to the floor space. The new structure will be entirely of arc-welded construction.

JACKSON ENGINEERING COMPANY has transferred its New York City office to 30 Church St. The main offices of the company have recently been transferred from Los Angeles, Calif., to Tulsa, Okla. N. M. Floyd, formerly of the Los Angeles office, has been placed in charge of the Eastern territory, with headquarters in New York.

CHICAGO PUMP COMPANY, Chicago, Ill., announces a change in its representative at Fort Worth, Texas. In the future the territory will be under the supervision of Sprekelmeyer-McDonald Company, 709 Pennsylvania Ave., Fort Worth, Texas.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has recently adopted a new sales policy. Hereafter products of the company will be handled by dealers in all industrial centers throughout the country.

WAGNER ELECTRIC COMPANY, St. Louis, Mo., announces the transfer of F. C. Hosimer from the St. Louis office to the Chicago branch sales office, where he will represent the company as salesman.

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION COMPANY, Pittsburgh, Pa., which recently underwent reorganization, now has C. A. Anderson, Jr. as president; A. V. Wadsworth as vice-president and general manager; J. B. Wentley as advertising and sales promotion manager, and W. H. Arnold as manager of sales.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.00 @ $2.35
Kanawha	Columbus	1.25 @ 1.55
Smokeless	Cincinnati	1.85 @ 2.00
Smokeless	Chicago	2.25
S. E. Kentucky	Chicago	1.35 @ 1.60
Steam	Pittsburgh	1.55 @ 1.65
Gas Slack	Pittsburgh	1.00 @ 1.10
Big Seam	Birmingham	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.50@$2.75
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Aug. 22, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75@5.25c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Aug. 13, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.4209 per bbl. or 42 gal.; 26@28 deg., $1.4709 per bbl.; 28@30 deg., $1.5209 per bbl.; 30@32 deg., $1.5709 per bbl.; 32@36 deg., gas oil, 4.276c. per gal.; 38@40 deg., distillate, 5.23c.

Pittsburgh—Aug. 20, f.o.b. local refinery, 30@34 deg., fuel oil, 4.5c. per gal.; 36@40 deg., 5c. per gal.

Philadelphia—Aug. 18, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Aug. 20, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—Aug. 9, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 85c. per bbl.; 30@32 deg., $1.00 per bbl.

Boston—Aug. 19, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal. 28@32 deg., 5.2c. per gal.

Dallas—Aug. 10, f.o.b. local refinery, 26@30 deg. $1.30 per bbl. or 42 gallons.

TRADE CATALOGS

VALVE RESEATERS—A circular pertaining to the new Dexter gate valve reseating outfit has been published by the Leavitt Machine Company, Orange, Mass. The outfit described has a capacity for reseating gate valves from 1½ in. to 4 in.

STORAGE TANKS—Sectional cast-iron storage tanks of side-discharge, semi-octagonal design for holding ashes, coal, gravel and other materials of corrosive and abrasive nature are described in Catalog No. 14 of the Hahn Engineering Company, Lancaster, Pa. The catalog is illustrated with photographs and drawings.

SWITCHES — A complete description of the various types of Sauter electric time switches for the automatic control of all kinds of electrical circuits and devices are described by R. W. Cramer & Company, New York City, in a catalog recently issued. Photographs and drawings of mechanical details are a feature of the bulletin. A price list is included.

DIESEL ENGINES—Catalog No. 502S describes stationary Diesel engines manufactured by the Western-Enterprise Engine Company, Los Angeles, Calif. Catalog No. 502M describes marine Diesel engines manufactured by the same company. Illustrations of the principal features are embodied in the catalogs.

WATER WHEELS — Bulletin W205, published by James Leffel & Company, Springfield, Ohio, gives a description of a typical Leffel waterwheel installation, featuring the outside, or exposed type, gate-operating mechanism. A drawing showing the complete installation is of considerable interest.

PUMPS—The Byron Jackson Company, Berkeley, Calif., has released a bulletin describing its type S double-suction single-stage horizontally split case centrifugal pumps. This publication, No. 295, contains about 25 illustrations of the pumps, many showing specific installations in various services.

CHAIN DRIVES—An attractive bulletin describing silent-chain drives has been issued by the Ramsey Chain Company, Albany, N. Y. In this publication, No. 628, are included 85 pages of illustrations and data on power transmission with silent chain. Specifications and list prices are included.

INDICATORS — Four bulletins, 1262, 1263, 3261 and 3262, each of which illustrates and describes a complete indicating outfit for a particular type of engine, have been prepared by the Bacharach Industrial Instrument Company, Pittsburgh, Pa. Illustrations of correct and incorrect indicator diagrams taken from Diesel engines, as well as an analysis of these diagrams, are given in Indicator Practice Bulletin 2261, also recently issued.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Long Beach—Pacific Electric Railway Co., Pacific Electric Railway Bldg., Los Angeles, is having plans prepared for the construction of a group of terminal buildings including sub-station, car house, motor coach shops, etc. on Fairbanks Ave. Private plans.

Calif., Los Angeles—Eastern Outfitting Co., A. Sieroty, Pres., 620 South Main St., is having plans prepared for the construction of a 13 story loft building including steam heating system, elevators, etc., at 9th St. and Broadway. Estimated cost $1,250,000. C. Beelman, 1019 Union Bank Bldg., is architect.

Calif., Los Angeles—E. C. Wilson, 108 West Fremont Pl., is having preliminary plans prepared for the construction of a 12 story office building including steam heating system, two electric elevators, etc., at Wilshire Blvd. and La Brea Ave. to Meyer & Holler, 315 Wright and Callender Bldg. Estimated cost $1,000,000.

Calif., Sacramento — City plans an election Oct. 10 to vote $11,600,000 bonds for the construction of Silver Creek water project including dam in Union Valley and 60 mi. conduit to Sacramento. B. C. Clark is city engineer.

Calif., Ventura — City Council, will receive bids until Sept. 3 for waterworks improvements including pumping plant, etc. D. C. McMillan is city engineer.

Conn., Hartford—State of Connecticut, Hartford, plans the construction of an office building at Washington and Capitol Aves. Estimated cost $2,250,000. Smith & Bassett, 36 Pearl St., are architects.

Florida—E. F. Power Construction Co., West Palm Beach, has been awarded contract for excavation work including two unit and single unit pumping plants in Pahokee district, a single unit pumping plant near Clewiston for Southern Sugar Co. and a three unit pumping plant in South Florida conservancy district. Estimated cost $175,000.

Fla., Miami—City awarded contract for the construction of a sewage system including pumping station to Everglades Construction Co., Hialeah, $12,327.

Fla., Miami—Seminole Ice Co., South River Dr., had plans prepared for the construction of an ice and cold storage plant. Estimated cost $18,000 to $20,000. Private plans. Work will be done by owner's forces.

Idaho, Malad — Deep Creek Irrigation Co., plans the construction of a dam on Deep creek to impound 7000 acre ft. of water. Estimated cost $100,000. Engineer not announced.

Ill., Chicago—P. F. Olsen, archt., 720 Cass St., soon takes bids for a 13 story apartment, 52nd St. and Blackstone Ave., for J. H. Cundy, c/o archt. Estimated cost $2,000,000.

Ind., Indianapolis—Bd. of Health, awarded contract for the construction of a hospital to W. P. Jungelas Co., 825 Massachusetts Ave. $516,000. Bids received on switchboard and electric wiring, turbine generator, coal and ash handling equipment, boilers, boiler feed pumps, stokers, etc.

Ia., Sioux City—Syndicate, c/o F. S. Martin Realty Co., is having sketches made for the construction of a hotel at 616 Nebraska St. Estimated cost $1,500,000. Holabird & Root, 333 North Michigan Ave., Chicago, Ill., are architects.

Kansas — United Power & Light Corp., Abeline, plans rebuilding power plant and installing two 1,100 hp. generating units at Junction City; construction of a hydro-electric plant and installing a new 3,000 kw. synchronous condenser at Rocky Ford in connection with proposed 66,000 v. steel tower transmission Line from Tecumseh station of Kansas Power & Light Co. near Topeka through Manhattan Junction City, Abilene and Salina to Hutchinson. B. G. Slining, will direct construction work.

La., Alexandria—Louisiana Ice & Utilities Co., will soon award contract for the construction of an ice plant. S. Stone Jr. & Co., Masonic Temple, New Orleans, are architects.

Md., Annapolis—Annapolis Water Co., F. H. Thompson, Secy. and Treas., will receive bids until Sept. 16, for the construction of a filter and pumping station at Water Purification Works.

Mass., Lowell—Lowell Ice Co., Middlesex St., is receiving bids for the construction of an ice hockey skating rink at Jackson and Middlesex Sts. Estimated cost $100,000. H. P. Graves, 40 Middlesex St., is architect.

Mass., Provincetown—Provincetown Art Association, W. H. Young, Pres., 10 Carver St., will build a boiler room and heating system at art building, Commercial St. Private plans. Work will be done by day labor.

Mass., Watertown—Boston Elevated Railway Co., Statler Bldg., Boston, will build a 1 and 2 story electric sub-station on Cottage St. here. Estimated cost $40,000. Work will be done by day labor.

Mich., Grand Rapids—Furniture Capitol Corp., G. A. Hendricks, Pres., 155 Campau Ave. N. W., plans the construction of a 13 story exposition building on Lyons St. Estimated cost $3,118,000. Architect not announced.

Minn., Duluth—Duluth Steam Corp., has been granted franchise by City Commissioners to construct and operate a steam generating plant at Third Ave. W. and Commerce St. Estimated cost $1,250,000.

Miss., McComb — Southern United Ice Co., Eugene Loche, Mgr., is having preliminary plans prepared for the construction of an ice storage warehouse. Estimated cost $75,000.

Mo., Clayton—St. Louis County, W. E. Miller, Clk., Court House, will receive bids until Sept. 5 for the construction of a group of hospital buildings including steam heating system, elevators, etc. at North and South Road. Aegerter & Bailey, Railway Exchange Bldg., St. Louis, are architects.

Mo., St. Louis—Texas Co., 2414 De Kalb St., awarded contract for the construction of a garage and warehouse including boiler room, etc., at Brown St. and Kingshighway, to McKelvey-Carter Co., 3800 West Pine St. Estimated cost $100,000.

Neb., Omaha—Creighton University, W. J. Grace, Pres., will receive bids until Aug. 27 for the construction of a 4 story faculty building, also addition to power plant. Estimated cost $200,000. L. A. Daly, Peters Trust Bldg., is architect.

Neb., South Sioux City—City awarded contract for the construction of two pumping stations in connection with sewage treatment plant to A. Dobson & Co., 824 First National Bldg., Lincoln. Estimated cost $100,000.

N. J., Allenhurst—Eastern New Jersey Power Co., 601 Bangs Ave., Asbury Park, is receiving bids for addition to power plant here. Estimated cost $50,000. Management Engineering & Development Co., Electric Bldg., Asbury Park, is engineer.

N. J., Newark—Dept. of Institutions and Agencies, State Office Bldg., Trenton, received lowest bid for the construction of an airplane hangar and boiler house from Shore Construction Co., 94 Christie St., Newark. Estimated cost $150,000.

N. J., Newark—North Jersey District Water Supply Commission, will receive bids until Sept. 10, for the construction of a pumping station in connection with headworks of Wanaque aqueduct.

N. J., Plainfield—Public Service Electric & Gas Co., 80 Park Pl., Newark, awarded contract for the construction of a 65 x 135 ft., addition to power plant at Madison Ave. and West Second St. here to Public Service Production Co., 80 Park Pl., Newark. Estimated cost $40,000.

N. J., Summit — Delaware, Lackawanna & Western R.R. Co., Hoboken Terminal, Hoboken, is receiving bids for the construction of a substation here. Estimated cost $40,000. G. J. Ray, is chief engineer.

N. Y., Long Island City—New York & Queens Light & Power Co., Bridge Plaza, plans the construction of a 9 story office building at Roosevelt Ave. and Lawrenice St. Estimated $1,075,000. T. R. Eilenberg, 40-22 Lawrence St., is architect.

N. Y., New York—Forty Seven East 88th St. Corp., A. M. Rae, Pres., 2095 Broadway, will receive bids after Sept. 1 for the construction of an apartment building. Estimated cost $1,100,000. G. F. Pelham, 570 7th Ave., is architect.

N. Y., New York—J. Paterno, 601 West 115th St., plans the construction of a 20 story apartment building at Park Ave. and 95th St. Estimated cost $4,000,000.

N. C., Roanoke Rapids — Virginia-Carolina Power Co., has made application to Federal Power Commission for permit for a hydro-electric plant and dam, 33,000 hp. on the Roanoke River in Halifax and Northampton counties.

O., Canton—Onesto Hotel Co., 218 Cleveland Ave., awarded contract for the construction 13 story hotel, Cleveland Ave., to H. L. Stevens Co., 30 Michigan Ave., Chicago, Ill. Estimated cost $600,000. Noted July 16.

O., Conneaut—Bd. of Control, plans extensions and improvements to waterworks including pump house, mains, etc. Engineer not announced.

O., Dayton—U. S. Engineers Office, War Dept., will receive bids until Sept. 4 for the construction of a boiler house, stack and tunnel including mechanical equipment and utilities at Wright Field.

O., Salem—City plans the construction of a waterworks system including dam, pumping station, etc. Estimated cost $200,000.

O., Toledo—Ohio Savings Bank & Trust Co., awarded contract for a 25 story bank and office building on Madison Ave. to A. Bentley & Sons Co., Belmont St. Estimated cost $3,000,000. Steam heating, ventilation and refrigeration system, boilers, pumps, elevators, etc., will be installed.

Okla., Nowata—City plans the construction of a power plant. Estimated cost $40,000. E. W. Gantt Co., 604 Continental Bldg., Oklahoma City, is engineer.

Ore., Portland—Inland Power & Light Co., has been granted permit for a 170,000 hp. project on Lewis River.

Pa., Coatesville — U. S. Veterans' Bureau, Arlington Bldg., Washington, D. C., will receive bids until Sept. 17 for the construction of a pump house and gas meter house at U. S. Veterans' Hospital here.

Pa., Grove City — Cooper Bessemer Corp., plans the construction of a power plant. Private plans.

Pa., Philadelphia—Rodman Wanamaker Est., W. N. Nevin, c/o Wanamaker's City Hall Sq., plans the construction of a store and office building at Broad and Chestnut Sts. Estimated cost $5,000,000. J. T. Windrim, Commonwealth Bldg., is archtect.

Pa., Pittsburgh—Gulf Refining Co., Frisk Annex, plans the construction of an office building, 7th and Grant Sts. Estimated cost $1,000,000. Trowbridge & Livingston, 527 5th Ave., are architects.

Pa., Pittsburgh — Pennsylvania College for Women, Woodland Rd., plans the construction of a power plant. Estimated cost $40,000.

Pa., Pittsburgh—U. S. Engineer's Office, War Dept., will receive bids until Sept. 9, for the construction of a hydro-electric plant for Deadman Island Locks, Ohio River.

Tex., Crystal City—Central Power & Light Co., Frost Bank Bldg., San Antonio, awarded contract for the construction of an ice storage building here to Sumner Sollitt Co., National Bank of Commerce Bldg., San Antonio. Estimated cost $60,000.

Tex., Denton—City awarded contract for the construction of an 86 x 208 ft. power plant to Denton Construction Co. Estimated cost $45,000.

Tex., Port Arthur—Gulf States Utilities Co., 362 Liberty St., Beaumont, awarded contract for the construction of a power substation here to Stone & Webster Inc., 49 Federal St., Boston, Mass. Estimated cost $70,000.

Tex., Yoakum—Swift & Co., 115 South Medina Ave., San Antonio, plans the construction of a cold storage plant here. Estimated cost $50,000. Private plans.

Tex., Richmond — City, c/o E. C. Farmer, Mayor, will receive bids about Aug. 26 for the construction of a sewage disposal plant and pumping plant. Estimated cost $45,000. Former bids rejected.

Tex., San Antonio—Swiss Plaza Co., c/o F. L. Hillyer, Bedell Bldg., plans the construction of a hotel at 5th and 7th Sts. Estimated cost $1,000,000.

Va., Richmond—Virginia Electric & Power Co., 7th and Franklin Sts., is having preliminary plans prepared for the construction of a hydro-electric plant, 25,000 kw. capacity on the Roanoke river.

Wash., Vancouver—City has made application to Federal Power Commission for preliminary permit for a proposed development, 80,000 hp. capacity on the north fork of Lewis River, one-half mi. above mouth of Swift Creek.

Wash., Seattle—Washington Gas & Electric Co., Washington C. H., Ohio, has been granted preliminary permit for an initial installation of 72,000 hp. and ultimate installation of 192,000 hp. on Columbia River in Chalan and Douglas counties.

W. Va., Sandstone — New Kanawha Power Co., has been granted permit to construct a hydro-electric dam at Sandstone (New Richmond) falls on New River.

Wis., Milwaukee—Milwaukee Gas Light Co., 128 East Milwaukee Ave., awarded contract for the construction of a 20 story office building on Wisconsin Ave., to H. Schmitt & Sons, 14 Burleigh St. Estimated cost $1,500,000. Steam heating system, elevators, etc. will be installed.

Ont., Hamilton—S. E. OB'rien, secy., Department Public Works, Parliament Bldgs., Ottawa, soon takes bids for the construction 3 story research building, including steam heating system, etc. for National Research Council, Parliament Bldgs., Ottawa. Estimated cost $2,000,000.

Manitoba—British Dominions Power Co. of Canada Ltd., has been granted permit by the Canadian Government for survey and possible development of White Mud Falls power site on Nelson river, thirty miles from Hudson Bay line at Niska.

Ont., Niagara Falls — United International Hotels Inc., F. A. Dudley, Pres., Niagara Hotel, Niagara Falls, N. Y., is having plans prepared for the construction of a 12 story addition to hotel including steam heating system, etc. here. Estimated cost $1,000,000. Esenwein & Johnston, Buffalo, N. Y., are architects.

Ont., Ottawa—Bank of Montreal, H. O. St. James St., Montreal, Que., plans the construction of a bank and office building including steam heating and ventilation systems, electric elevators, etc. on O'Connor St. Estimated cost $1,000,000. Barott & Blackader, Canada Cement Bldg., Montreal, are architects.

Equipment Wanted

Boiler Plant Equipment—Bureau of Yards & Docks, Navy Dpt., Washington, D. C., boiler plant equipment including portable fire box boilers, oil burners, turbine and motor driven air and oil pumping sets, oil heater, feed water heater, boiler feed and hot well pumps, etc., at Naval Ammunition Depot, Hawthorne, Nev.

Boilers, Pumps, etc.—Yale Laundry Co., 505 East Pine St., Portland, Ore., plans to purchase laundry machinery including boilers, pumps, etc. for proposed 2 story laundry. Estimated cost $45,000.

Boilers, Stokers, Air Preheaters, etc.—Bd. of Water Commissioners, W. T. Skrzycki, Pres., Detroit, Mich., will receive bids until Sept. 11, for two 1,000 hp. steam boilers with accessories, two underfeed stokers, two air preheaters, etc. for power plant, Springwells Station, West Warren Ave., Dearborn.

Coal Pulverizing and Burning Equipment, etc.—Dept. of Public Works, S. E. O'Brien, Secy., Ottawa, Ont., will receive bids until Sept. 4 for coal pulverizing and burning equipment and boiler settings at Central heating plant.

Grain Elevator Equipment—Galveston Wharf Co., c/o F. W. Parker, Galveston, Tex., is receiving bids for equipment including sixteen auto power grain shovels, auto fire pumps, electric power motors, etc. for proposed grain elevator, 3,000,000 bu. capacity. $2,000,000.

Motors, etc.—A. L. Flint, General Purchasing Officer of Panama Canal, Washington, D. C., will receive bids until Aug. 28 for electric motors, oil circuit breakers, transformers, switches, etc.

Oil Engines—City of West Point, Miss., oil engines for water and light plant.

Pumping Units—City of Delray Beach, Fla., will receive bids until Sept. 16 for furnishing and installing four motor driven and one engine driven centrifugal pumping units, etc. for proposed pumping station.

Refrigeration Equipment, Etc.—Dept. of Mental Diseases, State House, Boston, Mass., will receive bids until Aug. 30 for refrigeration equipment, etc. at Metropolitan State Hospital, Waltham, Mass.

Industrial Projects

Calif., Huntington Park—MACHINERY FACTORY—Axelson Machine Co., 6160 South Boyle Ave., is having plans prepared for the construction of a 1 story, 120 x 220 ft. factory and 36 x 130 ft. office. Estimated cost $150,000. Private plans.

Calif., Los Angeles—AVIATION PLANT—California Aviation Club, represented by H. J. Barneson, 355 South Ardmore Ave., is having plans prepared for the construction of a plant including administration buildings, hangars, shops, etc. at National and Sawtelle Blvds. Estimated cost $1,500,000. A. C. Semrow, 410 Douglas Bldg., is engineer.

Calif., Los Angeles—RAILROAD BUILDINGS AND POWER HOUSE—Southern Pacific R.R. Co., 65 Market St., San Francisco, awarded contract for the construction of a group of railroad buildings including round house, machine shop, store house, power house, etc. at San Fernando Rd., here to Robert McKee, 515 Hewitt St., Los Angeles. Estimated cost $124,000.

Calif., Stockton—SUGAR REFINERY—Holly Sugar Corp., 453 South Spring St., Los Angeles, plans the construction of a sugar refinery here. Estimated cost $2,000,000.

Ga., Atlanta—TIRE PLANT—B. F. Goodrich Rubber Co., South Main St., Akron, O., is having plans prepared for the construction of first unit of plant, 4 story, 200 x 600 ft. on Hemphill Ave. here. Estimated cost $1,500,000. McDonald & Co., Southeastern Trust Bldg., Atlanta, are engineers. R. S. Fiske, Healey Bldg., is consulting engineer.

N. J., Newark—LAMP WORKS—Tung Sol Lamp Works, 95 8th St., will receive bids about Sept. 1 for the construction of a 4 story, 100 x 150 ft. factory. Estimated cost $300,000. Fougner & Gautier, 103 Park Ave., New York, are architects.

N. Y., New York—HAMMER FACTORY—Cutler Hammer Co., Southern Blvd. and 144th St., plans the construction of a 6 story, 90 x 159 ft. factory. Estimated cost $250,000. B. Ahlers, 110 West 40th St., is architect.

O., Cleveland — JIG FACTORY — Cleveland Universal Jig Co., E. F. Patterson, Secy., 2005 Rockwell Ave., awarded contract for a 2 story, 80 x 105 ft. factory at 13328 St. Clair Ave., to Ellsasser Construction Co., 1517 Prospect Ave. Estimated cost $50,000.

O., Cleveland—FACTORY—Cream Cone Machine Co., J. W. Taylor, Pres., 1874 East 59th St., is receiving bids for a 4 story, 56 x 65 ft. addition to factory at 5800 Hough Ave. Estimated cost $50,000. Private plans.

O., Cleveland—FACTORY—Electric Products Co., 1725 Clarkstone Rd., had plans prepared for a 2 story, 80 x 90 ft. factory. Estimated cost $40,000. H. M. Morse, 750 Prospect Ave., is architect.

O., Cleveland—TUBE FACTORY—Linderme Tube Co., E. Linderme, Pres., 1291 East 53rd St., is having plans prepared for a 1 story, 60 x 100 ft. factory. Estimated cost $40,000. Kalsch & Hoefler, 4500 Euclid Ave., are architects.

O., Massillon—WASHER FACTORY—Reliance Mfg. Co., plans the construction of a factory for the manufacture of lock washers, lock washer wire, etc. Estimated cost $40,000 to $50,000. Private plans. Cutting, polishing and other equipment will be required.

Pa., Arnold — TUBE MILL ADDITION — Aluminum Co. of America, New Kensington, will build a 1 story, 155 x 425 ft. addition to tube mill here. E. S. Fickes, Oliver Bldg., Pittsburgh, is chief engineer. Tube draining and heat treating equipment will be required.

Tex., Paris—PRODUCE PLANT COOLING FACILITIES, ETC.—Swift & Co., Union Stock Yards, Chicago, Ill., plans the construction of a produce plant including cooling facilities, etc. here. Estimated cost $150,000. Private plans.

Ont., Copper Cliff—COPPER REFINERY—Ontario Refining Co., has work under way on the construction of a copper refinery including electrolytic cell house, 300 x 400 ft., two casting buildings one for crude copper and other for refined copper, 200 x 400 ft. and three furnaces. Estimated total cost $5,000,000.

Ont., Hamilton — GALVANIZED WIRE PLANT—Steel Co. of Canada, H. A. Champ, Mgr., is having plans prepared for the construction of a plant on Burlington St. Estimated cost $500,000. Private plans.

Ont., Windsor—SERVICE PLANT—Firestone Tire & Rubber Co., Hamilton, is having plans prepared for the construction of a service plant at Goyeau and Erie Sts. here. Estimated cost $100,000. Hutton & Souter, 5 James St., South Hamilton, are architects. Complete equipment will be required.